COMPAQ

A Structured Approach to the Design of Statistical Training Courses

Pedagogical Body of Knowledge for Statistical Methods

Volume 1

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January 11, 1991

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Foreword

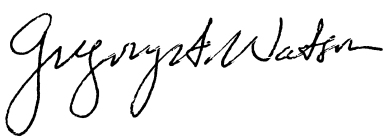
In 1990 the Compaq Computer Corporate Quality Office engaged the Bottom Line Group of Dallas, Texas, in collaboration with its own internal subject matter experts (SMEs), to analyze the body of statistical knowledge and conduct a needs assessment of statistical training required to support internal quality professionals (especially for Supplier Quality Engineers (SQEs). This project created a detailed body of knowledge of statistical methods which was compiled as a result of this in-depth needs assessment. Learning objectives were created and reference materials to develop a comprehensive approach to integration of statistical methods into a structured problem-solving method were developed.

Leading the project on the Compaq team was Doug Lowry with his team of statistical and quality Subject Matter Experts (SMEs) from the Compaq Quality Development Office: Denise Myers, Stacey Harman, Anita Joyce, and Joe Wexler. This team was supported by Laurie Albrecht and her team from BLG on the technical aspect of needs assessment and instructional design: Robert Damelio, Beverley Forte, and Bob Frost.

These four notebooks were created during this project and they have served as the basis for a complete revision of internal training materials used for developing quality competence among Compaq SQEs and all quality employees by their use in all quality training.

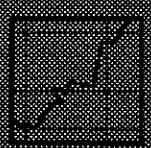
This material was provided to the SEMATECH Consortium's Statistical Working Group (SWG) and is being released publicly available as a service to the business partners and suppliers of Compaq Computer.

Sincerely,



Gregory H. Watson
Director, Corporate Quality

DATA I - VOLUME 1
ANALYSIS DOCUMENT
1/11/91



Prepared by

THE BOTTOM LINE GROUP
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Every moment spent planning saves three or four in execution

Crawford Greenwalt
President, DuPont
Mackenzie, *The Time Trap*
(McGraw-Hill, 1972)

Company Mission

THE BOTTOM LINE GROUP (BLG) is a management consulting firm located in Irving, Texas. Our mission is to help companies enhance the skills of their people, increase the effectiveness of work processes, and identify opportunities to improve company performance. The results are increased productivity, quality, and customer satisfaction.

Our Vision

We are driven to be a world-class firm dedicated to the practice of organization improvement and effectiveness. Our measure of success is the perceived value of our contributions to our client organizations. We believe that the only thing more powerful than the right idea at the right time is the ability to transform those ideas into actions which produce organization results. These are the aims for which we strive.

Our Goal for the Data I Course Development Project

To provide the students with performance changing training. BLG provides a systematic approach to producing training.

Information vs Training

	Information	*Training*
Interaction	One-Way	Two-Way
Acquiring Skills	No skills required	Works well when new job skills are needed
Results	Wide variance in comprehension and application	Reduces variance in comprehension and application
Practices	None or few practices	2/3 of course is practice

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The Purpose of the Analysis Document

This document records the results of the Data I analysis phase. This document is for review and approval purposes. It details the statistics content to be covered in the Data I course and the process used to gather the data.

Reading the Document

This is meant to be a working document. Please record your comments, questions, requirements, or concerns directly on the page as you review the document.

There are review checklists throughout the document used to record your final opinion of the content in that section. Reviewing the content is a tedious task but one of the most important in the entire instructional design process. The content in this document is the basis of the material to be taught in the course. The more accurately the content is documented now, the more development time will be saved.

The document should be read for two critical dimensions: completeness and accuracy. Completeness means the content covers the width and depth correctly. Accuracy means that the material presented is correct.

Acronyms

There are a few acronyms used throughout the document:

BLG - THE BOTTOM LINE GROUP
ISD - Instructional Design
SME - Subject Matter Expert
SQE - Supplier Quality Engineer

Analysis Document Summary Statement

Data I will cover knowledge and application level content for statistical tests. The statistical tests will be learned within a data driven decision making business process. The scope of the training will cover all four Point Estimation/Confidence Interval tests to the application level. Hypothesis testing, correlation, and regression will be introduced and a strong relationship between the Data I and Data II courses will be established.

Several job aids will be developed to facilitate learning. Selecting the correct statistical test, using statistical software packages, and performing one-sample t tests were identified by the target population in the Needs Assessment document as training needs (as the Needs Assessment document relates to Data I).

The design of the course will be modular, in sections no longer than 4 hours. There will be several mini-workshops to meet the objective of 1/3 presentation, 2/3 practice. The preliminary estimate of classroom time is a minimum of 16 hours.

Client Request for BLG Services

Laurie Albrecht from THE BOTTOM LINE GROUP (BLG) was contacted to discuss the need for two Statistics courses at a high level. BLG would be contacted by the Compaq project leads for specific project direction, requirements, and start dates. BLG would provide consulting, instructional design, and desktop publishing services as requested. Consulting services would include project management, project direction, facilitating, quality technologies input, content clarification, instructional design training for personnel, and any meetings associated with the above. Instructional design services would include analyzing, designing, and developing training materials. Desktop publishing services include creating original graphics and the desktop publishing necessary to produce camera ready materials.

Desktop publishing software requirements would be communicated from BLG to the Compaq production staff upon completion of the project.

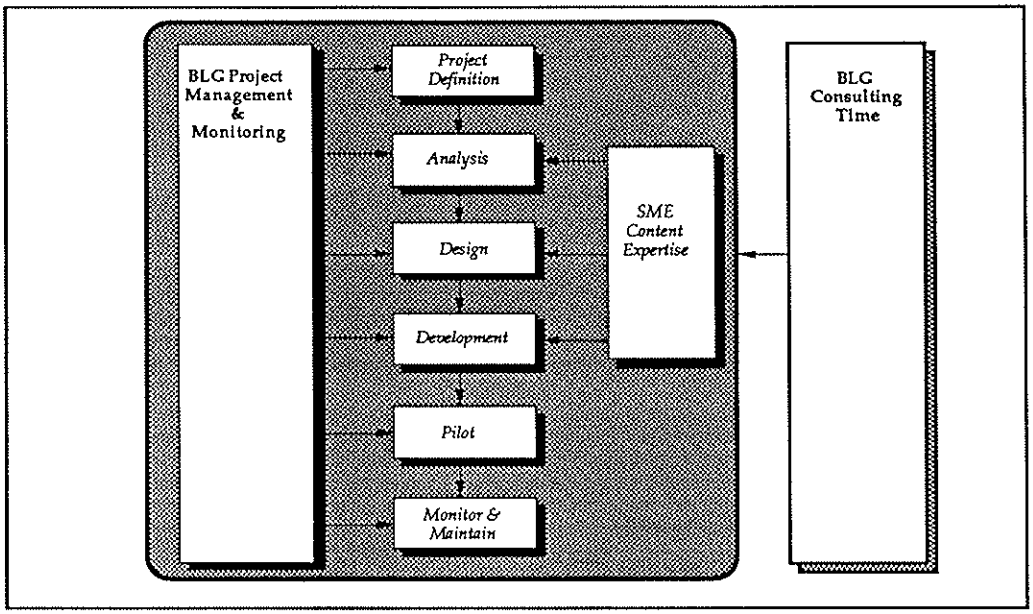
Customer Requirements

- Modular course design
- Maximum time allowed per module is 2 - 4 hour chunks
- Training materials to be delivered:
  - Facilitator Guide
  - Participant Guide
  - Participant Reference Guide (key learnings, formulas, specific target population examples)
  - Exercise Guides
  - Pre- and Post-tests
  - Help Aids
  - Overheads
  - A master set of camera ready course materials for printing and associated software disks
- This course should serve as a template course for other target populations. The content (exercises, examples) will be revised to serve a new audience.

Project Constraints

- Availability of Subject Matter Expert (SME) time to resolve content issues and review material
- SQE committment to help with development of exercises
- Software availability

BLG Instructional Design (ISD) Project Process



What happens in the ISD process?

Project Definition: Clarify customer requirements and project goals. For Data I details, see page 3-1.

Analysis: Produce an analysis document that identifies the necessary outputs, tasks, skills, and knowledge that affect job performance. For a detailed explanation of this phase as it relates to the Data I project refer to Data Collection methods on page 5-1.

Design: Produce a design document that details the goals, objectives, examples, materials, and media selection for the course.

Development: Develop actual training materials to pilot. For a list of the training materials, see page 3-1.

Pilot: Test training materials with a small portion of target population.

Monitor & Maintain: With the client, create a plan to review and update the material as needed.

Project Results: Facilitator Guide, Participant Guide, Participant Reference Guide (key learnings, formulas, specific target population examples), Exercise Guides, Pre- and Post-tests, Help Aids, Overheads, a master set of camera ready course materials for printing, and associated software disks.

Project Roles and Responsibilities

Compaq Data I Project Lead: Stacy Harmann

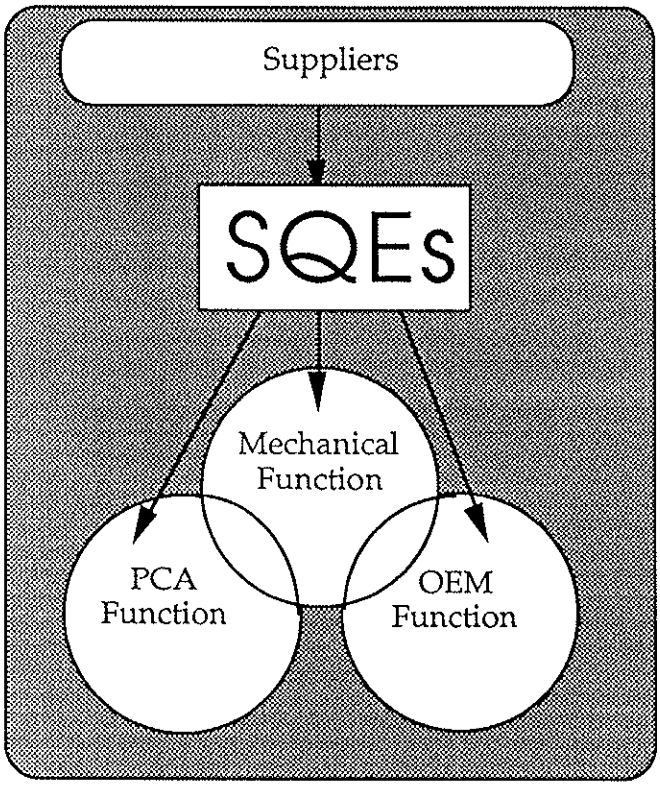
BLG Instructional Design Team: Laurie Albrecht, Beverly Forte, and various desktop publishing support personnel

BLG	*Analysis Activities*	*Compaq*
• Provide ISD Project Process and Direction • Surface Content Issues		• Free-up Schedule to Work on Project • Resolve Content Issues
• Create and Synthesize Needs Assessment Document	Needs Assessment Survey	• Distribute and Collect Needs Assessment Documents
• Conduct Work Sessions; Collect Data • Create and Synthesize Content • Identify Width and Depth of Training Required	Subject Matter Analysis- Work Sessions	• Schedule Meetings • Provide SME Content • Review and Approve Content • Review Content with Internal Compaq Client
• Conduct Research and Extract Content • Merge Content into Compaq Culture/Processes • Identify Exercise/Example Parameters	Subject Matter Analysis - Content Research	• Collect Exercise and Example Materials
• Research Software Options	Software Research	• Resolve Software Issues
• Create Analysis Document • Conduct Analysis Document Review Meeting		• Review and approve Analysis Document • Attend Analysis Document Review Meeting

TARGET POPULATION INFORMATION

The target population has been identified as the Supplier Quality Engineers (SQEs) in the USA. This course may be given overseas, but international considerations (language, metrics, phrasing, etc.) were not considered for this project.

SQEs act as the interface between Compaq internal functional areas and external suppliers. BLG's goal is to provide the students with performance-changing training. In order to do that, we first examined the SQE job accomplishments.



The SQE job accomplishments that the Data I course will effect are:

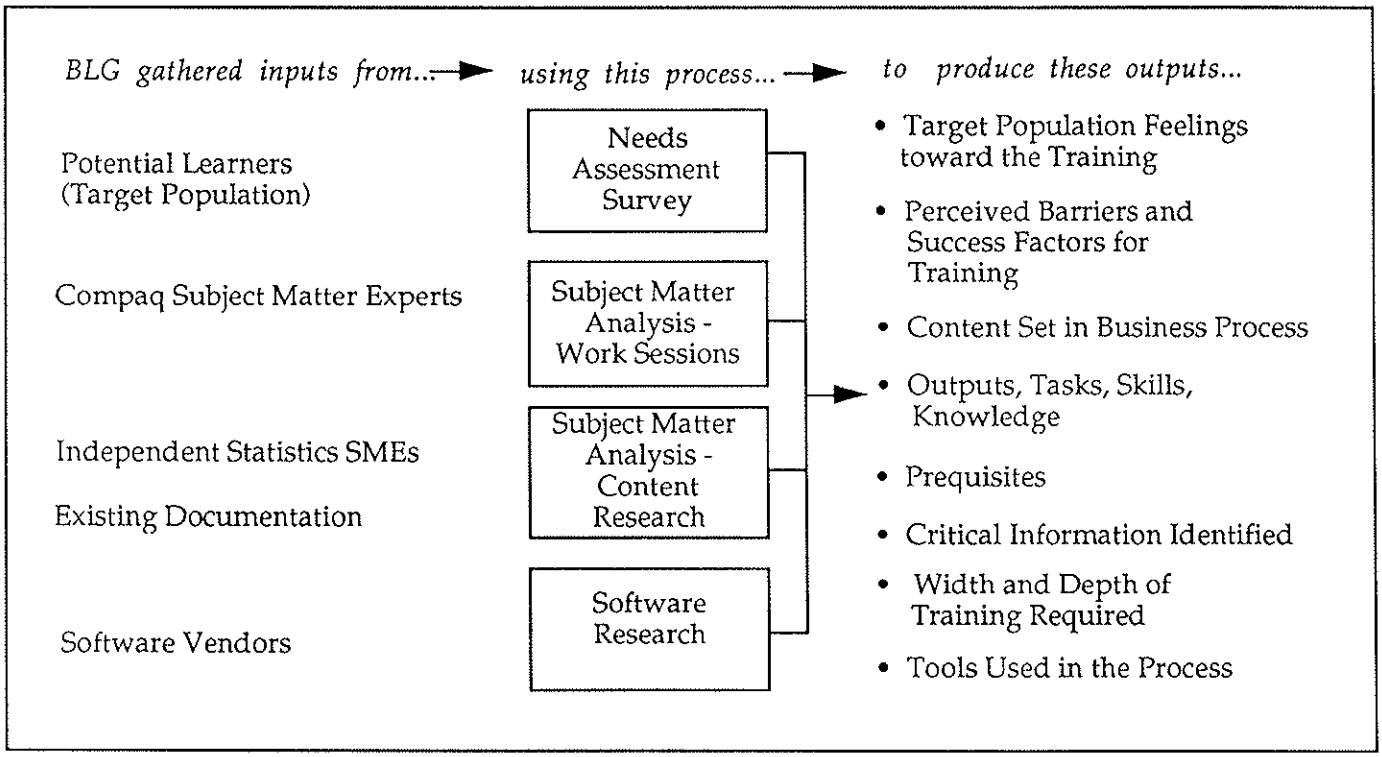
- Monitor product performance for functional area specification acceptance
- Evaluate product performance for functional area specification acceptance:
  - Make decisions regarding product acceptability
  - Make purchasing decisions (is one vendor's price significantly better than the other's)
  - Add or change a vendor
  - Troubleshoot a supply product problem on the line

The content's relationship to statistics: statistics are used to quantify the decisions.

DATA COLLECTION METHODS

Analysis is a labor intensive search for the content and synthesis of that content into the business application. There were four major activities in this phase: Needs Assessment, Subject Matter Analysis (work sessions and content research), and Software Research.

The SMEs used to generate the statistical content were: Denise Meyers, Anita Joyce, Stacy Harmann, Bob Frost (BLG), and Beverly Forte (BLG). Approximately 75% of the total effort went into subject matter analysis and the remaining 25% was spent on the Needs Assessment Survey and the software research.



The data produced for each of these activities can be located:

The results from the	*are located behind tab*
Needs Assessment	Needs Assessment
Subject Matter Analysis	Analysis Results, Level I, II, and III
Software Research	Appendix C

Purpose

The Needs Assessment survey was created to collect information from a sample of the target population regarding their feelings, perceptions, and knowledge regarding statistics and their job.

There were four major questions:

1. *What were the manager's, supervisor's, and nonsupervisory personnel's perception of their need for statistics training?*

2. *What are the top statistical content training needs?*

3. *What are the statistical tests on that training is needed?*

4. *Why don't people use statistics?*

5. *Does the perception of needs match to an actual knowledge test result?*

Twenty-two surveys were sent out. Eleven were returned; eight were returned from nonsupervisory personnel, three were received from supervisors, the single manager targeted did not respond. An actual numerical count was recorded on the Needs Assessment form in Appendix A. The data has been entered into a database that can be manipulated in any fashion as requested.

Results

1. *What were the manager's, supervisor's, and nonsupervisory personnel's perception of their need for statistics training?*

Most answered the question that they were currently using statistics but would like to broaden their knowledge and application. This question was asked to get a three way match between target population, their managers, and their customers. There was a high correlation between the perceptions of all three.

2. *What are the top statistical content training needs?*

What is your current need for training? The answers are in rank order, 1 being the highest need.

***1	Choosing the correct statistical test *This was identified as critical in the Needs Assessment Document. The data on page 11-4 suggests we need to increase the emphasis of this task. (See Select the Relevant Statistical Test - 12%)*	
2	Statistical software	
3	Nonparametric	*Note: Numbers 2-5 are going to be covered to the application level in Data II, and to a knowledge level in Data I.*
4	Hypothesis Testing	
5	Chi Square	
6	Attribute, variable, discrete, continuous	*Note: From 6 down will be covered to a knowledge and application level in Data I, as it relates to a statistical test. Concepts will wrap around application. Lots of mini-workshops.*
6	Point estimation	
6	Probability	
6	Independent and dependent event	
7	How to collect data	
8	Correlation	
8	Skewness	
9	Regression	
10	Poisson	
10	Sampling methods	
10	Confidence Intervals	
11	Variance	
12	Binomial	
13	Standard Deviation	
14	Distribution	
15	Mean, median, mode, average - when to use and the differences	
16	Charts (bar, pie, histogram, Pareto)	

3. *What are the statistical tests that training is needed on?*

What is your current need for training for the specific statistical tests? The answers are in rank order, 1 being the highest need.

1	Binomial	
2	Chi square test for binomial proportion (Two or more samples)	
***2	*One-sample t test*	*Note: Only One-sample t test will be covered briefly in the Data I course, the rest are application level in Data II.*
2	Two-sample t test	
3	F test	
4	Multiple Regression	
5	One-way ANOVA	
5	Two-way ANOVA	
5	Curvilinear Regression	
5	Chi square for binomial	
5	Chi square test for binomial proportion (one-sample)	
6	Linear Regression	
7	Wilcoxon Rank Sum	
7	Kruskal-Wallis	
8	Correlation	
9	Wilcoxon Signed Rank	
9	Spearman	

4. *Why don't people use statistics?*

Question 9 on the document rank ordered from 1 being the most common reason why people don't use statistics.

1. Lack of training - we would like to do it, but we don't know how
2. Lack of resources, not enough manpower or equipment
3. Lack of time - not enough time with current workloads
4. Lack of equipment or tools; there are not enough available
5. Lack of motivation - our staff doesn't see the benefits of using statistics
6. Lack of feedback
7. Lack of customer support - customers do not see this as a priority
8. Lack of management support - management does not see this as a priority
8. No one is asking us to use statistics in our department
9. Statistics are not needed in our department

5. *Does the perception of needs match to an actual knowledge test results?*

Question 27 on the Needs Assessment Document consisted of five knowledge questions. As the questions increased in difficulty, the confidence level decreased. For the most part, reference materials were not used and the majority of the answers were made with some reservations. Help aids may increase this confidence level if they do not look up the material.

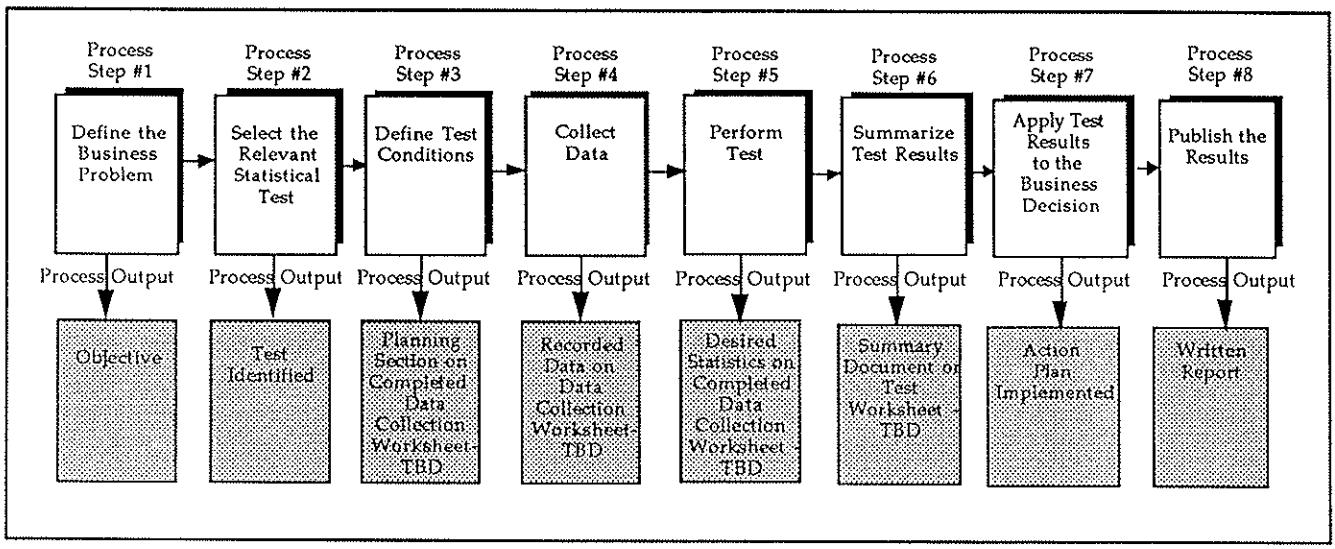
This first question dealt with mean, median, and mode. Mean was low on the need list, although data gathered by a Project Lead indicates there may be a higher need than the target population perceives. The second question dealt with Hypothesis Testing. Clearly there was a split in the ability and confidence level of the target population. The third question dealt with choosing the correct statistical test and One-way ANOVA. Again, at the confidence level was low. The fourth question dealt with variance, choosing the correct statistical test and two-sample t test. Most of the answers were correct, yet the confidence was not there. The last question dealt with choosing the correct statistical test, nonparametric, and Kruskal-Wallis. Only two of the eleven people answered the question and only one of those answers was correct. The need for nonparametic training was indicated in the Needs Assessment document; the learners have a real need here.

Based on the needs identified in the Needs Assessment document, another knowledge test may be needed given to check the perceived vs. the actual knowledge to make sure we do not provide too much training in areas the target population may already know.

The results of the Needs Assessment document suggest the perception of the target population does not necessarily match with their current knowledge level. This will need to be designed into the course strategies.

A key factor for project success is the degree to which statistics are used correctly in the business organizations. During the analysis phase, BLG worked with SMEs and project leads (who worked with their plant clients) to clarify and document client and learner requirements associated with the data driven business decision making process.

First, a data driven business decision-making process was identified. Review the graphic below and complete the review checklist.



Review the Process Flow for:

	Process Step OK?	Output OK?
1. Define the Business Problem	☐	☐
2. Select the Relevant Statistical Test	☐	☐
3. Define Test Conditions	☐	☐
4. Collect Data	☐	☐
5. Perform Test	☐	☐
6. Summarize Test Results	☐	☐
7. Apply Test Results to the Business Decision	☐	☐
8. Publish the Results	☐	☐

Page 7-2 provides a high level review of the tasks within each Process Step for each statistical test.

ADVANCED ORGANIZER
DATA DRIVEN DECISION MAKING PROCESS - DATA I

PROCESS STEPS	TASKS	1. Pt. Est./Conf. Intervals (Normal-Detailed)	2. Pt. Est./Conf. Intervals (Quick)	3. Pt. Est./Conf. Intervals (Binomial)	4. Pt. Est./Conf. Intervals (Poisson)	5. Hypoth. Test (Normal-Detailed)	6. Correlation	7. Regression
Publish the Results	Distribute the report	1.35	2.35	3.35	4.35	5.35	6.35	7.35
	Write the report	1.34	2.34	3.34	4.34	5.34	6.34	7.34
Apply Test Results to the Business Decision	Implement action plan	1.33	2.33	3.33	4.33	5.33	6.33	7.33
	Determine what action to take	1.32	2.32	3.32	4.32	5.32	6.32	7.32
	Apply answer from statistical objective to business objective	1.31	2.31	3.31	4.31	5.31	6.31	7.31
	Apply statistical answer to statistical objective	1.30	2.30	3.30	4.30	5.30	6.30	7.30
Summarize Test Results	Summarize analysis	1.29	2.29	3.29	4.29	5.29	6.29	7.29
Perform Test	Perform test					5.28	6.28	7.28
	Calculate confidence interval	1.27	2.27	3.27	4.27			
	Specify level of confidence	1.26	2.26	3.26	4.26			
	Calculate quartile deviation		2.25					
	Calculate standard deviation	1.24						
	Calculate *c*				4.23			
	Calculate *p*			3.22				
	Calculate median		2.21					
	Calculate mean	1.20						
	Determine if data is symmetrical		2.19					
	Determine if data is normal	1.18				5.18	6.18	7.18
Collect Data	Record deviations from specified conditions	1.17	2.17	3.17	4.17	5.17	6.17	
	Collect and record data	1.16	2.16	3.16	4.16	5.16	6.16	7.16
	Record actual conditions under which data was collected	1.15	2.15	3.15	4.15	5.15	6.15	7.15
	Select the experimental units	1.14	2.14	3.14	4.14	5.14	6.14	7.14
Define Test Conditions	Specify data collection requirements	1.13	2.13	3.13	4.13	5.13	6.13	7.13
	Determine if useable historical data is available	1.12	2.12	3.12	4.12	5.12	6.12	7.12
	Specify beta					5.11		
	Specify alpha					5.10	6.10	
	State variables						6.9	7.9
	State null (H_0) and alternative hypothesis (H_1)					5.8	6.8	
Select the Relevant Statistical Test	Write business objective in statistical terms	1.7	2.7	3.7	4.7	5.7	6.7	7.7
	Select test	1.6	2.6	3.6	4.6	5.6	6.6	7.6
	Select distribution	1.5	2.5	3.5	4.5	5.5	6.5	7.5
	Select type of evaluation	1.4	2.4	3.4	4.4	5.4	6.4	7.4
Define the Business Problem	Determine if statistics contribute to answering business problem	1.3	2.3	3.3	4.3	5.3	6.3	7.3
	Write an objective statement	1.2	2.2	3.2	4.2	5.2	6.2	7.2
	Write a problem statement	1.1	2.1	3.1	4.1	5.1	6.1	7.1

This matrix integrates the statistical test, process steps, and tasks necessary to complete the tasks.

This is a summary document.

Purpose of Level I Analysis:

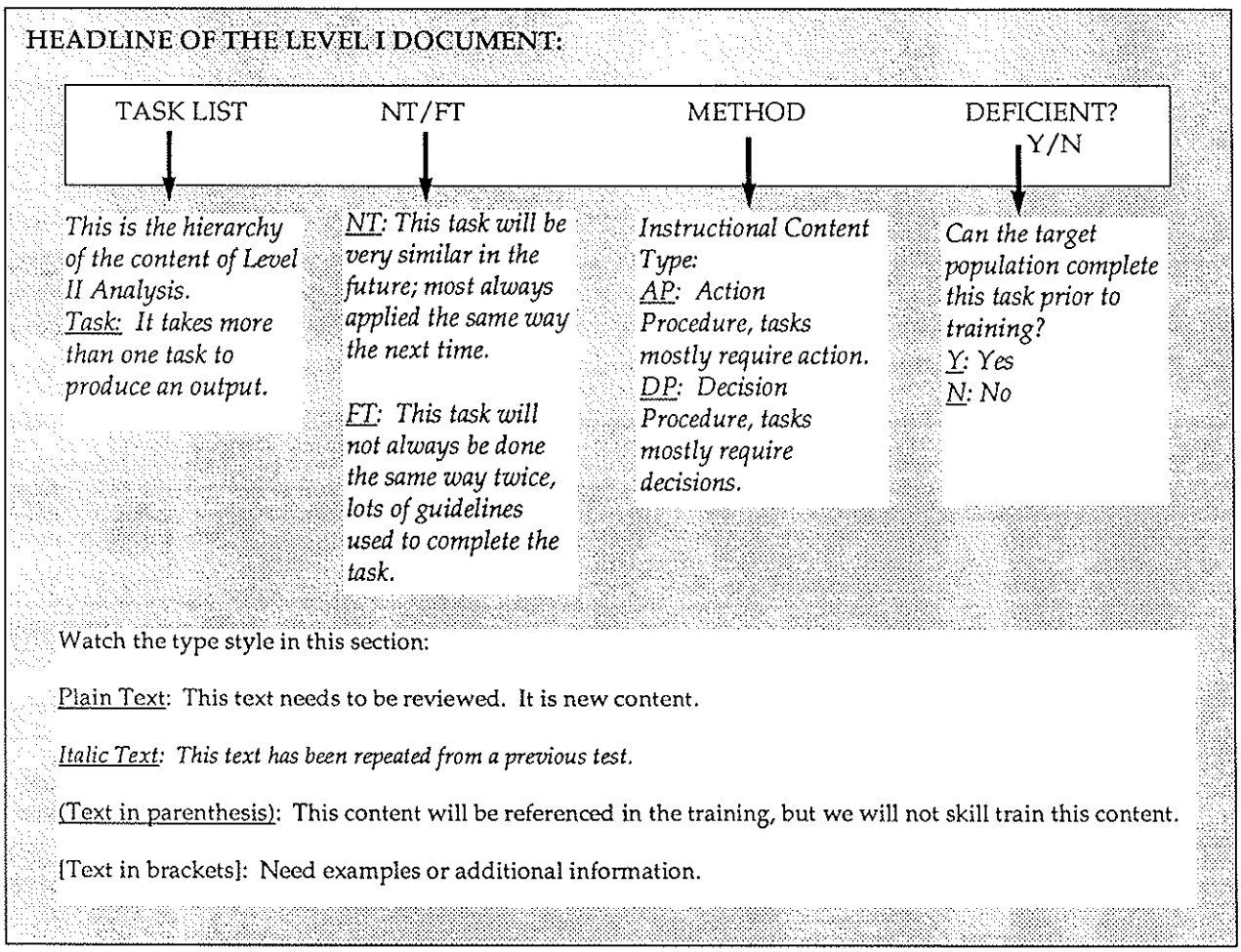
Level I Analysis identifies the Tasks inside the process, whether the task is near or far transfer (see graphic below for definitions), method, and deficiency.

Content Explanation

There are seven statistical tests which are separated by red sheets. The seven statistical tests are:

1. Point Estimation/Confidence Intervals (Normal-Detailed)
2. Point Estimation/Confidence Intervals (Quick)
3. Point Estimation/Confidence Intervals (Binomial)
4. Point Estimation/Confidence Intervals (Poisson)
5. Hypothesis Testing (Normal-Detailed)
6. Correlation
7. Regression

Below is a graphic explanation of the Level I document.



Review Level II Document for:

After you have read each test, turn back to this page and answer the questions below. Review again for completeness and accuracy. Also review the Deficiency Column. If the answer in the column indicates a Y, we will train to some level; a N indicates the target audience can accomplish the task without training.

Statistical Tests

	This section is OK as is. It is complete and accurate.	This section needs work. Completeness Issue	This section needs work. Accuracy Issue	Deficiency Column Review
1. Point Estimation/Confidence Intervals (Normal-Detailed)	❑	❑	❑	❑
2. Point Estimation/Confidence Intervals (Quick)	❑	❑	❑	❑
3. Point Estimation/Confidence Intervals (Binomial)	❑	❑	❑	❑
4. Point Estimation/Confidence Intervals (Poisson)	❑	❑	❑	❑
5. Hypothesis Testing (Normal-Detailed)	❑	❑	❑	❑
6. Correlation	❑	❑	❑	❑
7. Regression	❑	❑	❑	❑

Point Estimation/Confidence Intervals (Normal-Detailed)

1. POINT ESTIMATION/CONFIDENCE INTERVALS (NORMAL - DETAILED)

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 1: Define the Business Problem			
1.1 Write a problem statement	FT	AP	Y
1.2 Write an objective statement	FT	AP	Y
1.3 Determine if statistics will contribute to answering business problem	FT	DP	Y
Process Step 2: Select the Relevant Statistical Test			
1.4 Select type of evaluation	FT	DP	Y
1.5 Select distribution	NT	DP	Y
1.6 Select test	FT	DP	Y
1.7 Write business objective in statistical terms	NT	AP	Y
Process Step 3: Define Test Conditions			
1.12 Determine if useable historical data is available	FT	DP	Y
1.13 Specify data collection requirements	FT	AP	Y
Process Step 4: Collect Data			
1.14 Select the experimental units	FT	AP	Y
1.15 Record actual conditions under which data was collected	FT	AP	N
1.16 Collect and record data	FT	AP	N
1.17 Record deviations from specified conditions	FT	AP	N
Process Step 5: Perform Test			
1.18 Determine if data is normal	FT	DP	Y
1.20 Calculate mean	NT	AP	N
1.24 Calculate standard deviation	NT	AP	Y
1.26 Specify level of confidence	FT	DP	Y
1.27 Calculate confidence interval	NT	AP	Y

LEGEND

AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

1. POINT ESTIMATION/CONFIDENCE INTERVALS (NORMAL - DETAILED) cont.

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 6: Summarize Test Results			
1.29 Summarize analysis	FT	DP	Y
Process Step 7: Apply Test Results to the Business Decision			
1.30 Apply statistical answer to statistical objective	FT	DP	Y
1.31 Apply answer from statistical objective to business objective	FT	DP	Y
1.32 Determine what action to take	FT	DP	Y
1.33 Implement action plan	FT	AP	Y
Process Step 8: Publish the Results			
1.34 Write the report	FT	AP	Y
1.35 Distribute the report	NT	AP	N

LEGEND

AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

Point Estimation/Confidence Intervals (Quick)

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 1: Define the Business Problem			
2.1 *Write a problem statement*	*FT*	*AP*	*Y*
2.2 *Write an objective statement*	*FT*	*AP*	*Y*
2.3 *Determine if statistics will contribute to answering business problem*	*FT*	*DP*	*Y*
Process Step 2: Select the Relevant Statistical Test			
2.4 *Select type of evaluation*	*FT*	*DP*	*Y*
2.5 *Select distribution*	*NT*	*DP*	*Y*
2.6 *Select test*	*FT*	*DP*	*Y*
2.7 *Write business objective in statistical terms*	*NT*	*AP*	*Y*
Process Step 3: Define Test Conditions			
2.12 *Determine if useable historical data is available*	*FT*	*DP*	*Y*
2.13 *Specify data collection requirements*	*FT*	*AP*	*Y*
Process Step 4: Collect Data			
2.14 *Select the experimental units*	*FT*	*AP*	*Y*
2.15 *Record actual conditions under which data was collected*	*FT*	*AP*	*N*
2.16 *Collect and record data*	*FT*	*AP*	*N*
2.17 *Record deviations from specified conditions*	*FT*	*AP*	*N*
Process Step 5: Perform Test			
2.19 Determine if data is symmetrical	NT	DP	Y
2.21 Calculate median	NT	AP	Y
2.25 Calculate quartile deviation	NT	AP	Y
2.26 *Specify level of confidence*	*FT*	*DP*	*Y*
2.27 *Calculate confidence interval*	*NT*	*AP*	*Y*

LEGEND
AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 6: Summarize Test Results			
2.29 *Summarize analysis*	*FT*	*DP*	*Y*
Process Step 7: Apply Test Results to the Business Decision			
2.30 *Apply statistical answer to statistical objective*	*FT*	*DP*	*Y*
2.31 *Apply answer from statistical objective to business objective*	*FT*	*DP*	*Y*
2.32 *Determine what action to take*	*FT*	*DP*	*Y*
2.33 *Implement action plan*	*FT*	*AP*	*Y*
Process Step 8: Publish the Results			
2.34 *Write the report*	*FT*	*AP*	*Y*
2.35 *Distribute the report*	*NT*	*AP*	*N*

LEGEND
AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

Point Estimation/ Confidence Intervals (Binomial)

3. POINT ESTIMATION/CONFIDENCE INTERVALS (BINOMIAL) (cont.)

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 6: Summarize Test Results			
3.29 Summarize analysis	*FT*	*DP*	*Y*
Process Step 7: Apply Test Results to the Business Decision			
3.30 Apply statistical answer to statistical objective	*FT*	*DP*	*Y*
3.31 Apply answer from statistical objective to business objective	*FT*	*DP*	*Y*
3.32 Determine what action to take	*FT*	*DP*	*Y*
3.33 Implement action plan	*FT*	*AP*	*Y*
Process Step 8: Publish the Results			
3.34 Write the report	*FT*	*AP*	*Y*
3.35 Distribute the report	*NT*	*AP*	*N*

LEGEND

AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

Point Estimation/ Confidence Intervals (Poisson)

4. POINT ESTIMATION/CONFIDENCE INTERVALS (POISSON)

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 1: Define the Business Problem			
4.1 *Write a problem statement*	*FT*	*AP*	*Y*
4.2 *Write an objective statement*	*FT*	*AP*	*Y*
4.3 *Determine if statistics will contribute to answering business problem*	*FT*	*DP*	*Y*
Process Step 2: Select the Relevant Statistical Test			
4.4 *Select type of evaluation*	*FT*	*DP*	*Y*
4.5 *Select distribution*	*NT*	*DP*	*Y*
4.6 *Select test*	*FT*	*DP*	*Y*
4.7 *Write business objective in statistical terms*	*NT*	*AP*	*Y*
Process Step 3: Define Test Conditions			
4.12 *Determine if useable historical data is available*	*FT*	*DP*	*Y*
4.13 *Specify data collection requirements*	*FT*	*AP*	*Y*
Process Step 4: Collect Data			
4.14 *Select the experimental units*	*FT*	*AP*	*Y*
4.15 *Record actual conditions under which data was collected*	*FT*	*AP*	*N*
4.16 *Collect and record data*	*FT*	*AP*	*N*
4.17 *Record deviations from specified conditions*	*FT*	*AP*	*N*
Process Step 5: Perform Test			
4.23 Calculate c	NT	AP	Y
4.26 *Specify level of confidence*	*FT*	*DP*	*Y*
4.27 *Calculate confidence interval*	*NT*	*AP*	*Y*

LEGEND
AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 6: Summarize Test Results			
4.29 Summarize analysis	*FT*	*DP*	*Y*
Process Step 7: Apply Test Results to the Business Decision			
4.30 Apply statistical answer to statistical objective	*FT*	*DP*	*Y*
4.31 Apply answer from statistical objective to business objective	*FT*	*DP*	*Y*
4.32 Determine what action to take	*FT*	*DP*	*Y*
4.33 Implement action plan	*FT*	*AP*	*Y*
Process Step 8: Publish the Results			
4.34 Write the report	*FT*	*AP*	*Y*
4.35 Distribute the report	*NT*	*AP*	*N*

LEGEND
AP = ACTION PROCEDURE
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FT = FAR TRANSFER
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Hypothesis Testing
(Normal-Detailed)

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 1: Define the Business Problem			
5.1 Write a problem statement	*FT*	*AP*	*Y*
5.2 Write an objective statement	*FT*	*AP*	*Y*
5.3 Determine if statistics will contribute to answering business problem	*FT*	*DP*	*Y*
Process Step 2: Select the Relevant Statistical Test			
5.4 Select type of evaluation	*FT*	*DP*	*Y*
5.5 Select distribution	*NT*	*DP*	*Y*
5.6 Select test	*FT*	*DP*	*Y*
5.7 Write business objective in statistical terms	*NT*	*AP*	*Y*
Process Step 3: Define Test Conditions			
5.8 State null (H_0) and alternative hypothesis (H_1)	NT	DP	Y
5.10 Specify alpha	FT	DP	Y
5.11 Specify beta	FT	DP	Y
5.12 Determine if useable historical data is available	*FT*	*DP*	*Y*
5.13 Specify data collection requirements	*FT*	*AP*	*Y*
Process Step 4: Collect Data			
5.14 Select the experimental units	*FT*	*AP*	*Y*
5.15 Record actual conditions under which data was collected	*FT*	*AP*	*N*
5.16 Collect and record data	*FT*	*AP*	*N*
5.17 Record deviations from specified conditions	*FT*	*AP*	*N*
Process Step 5: Perform Test			
5.18 Determine if data is normal	*FT*	*DP*	*Y*
5.28 Perform test	NT	AP	Y

LEGEND
AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 6: Summarize Test Results			
5.29 Summarize analysis	*FT*	*DP*	*Y*
Process Step 7: Apply Test Results to the Business Decision			
5.30 Apply statistical answer to statistical objective	*FT*	*DP*	*Y*
5.31 Apply answer from statistical objective to business objective	*FT*	*DP*	*Y*
5.32 Determine what action to take	*FT*	*DP*	*Y*
5.33 Implement action plan	*FT*	*AP*	*Y*
Process Step 8: Publish the Results			
5.34 Write the report	*FT*	*AP*	*Y*
5.35 Distribute the report	*NT*	*AP*	*N*

LEGEND
AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

Correlation

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 1: Define the Business Problem			
6.1 Write a problem statement	*FT*	*AP*	*Y*
6.2 Write an objective statement	*FT*	*AP*	*Y*
6.3 Determine if statistics will contribute to answering business problem	*FT*	*DP*	*Y*
Process Step 2: Select the Relevant Statistical Test			
6.4 Select type of evaluation	*FT*	*DP*	*Y*
6.5 Select distribution	*NT*	*DP*	*Y*
6.6 Select test	*FT*	*DP*	*Y*
6.7 Write business objective in statistical terms	*NT*	*AP*	*Y*
Process Step 3: Define Test Conditions			
6.8 State null (H_0) and alternative hypothesis (H_1)	NT	DP	Y
6.9 State variables	FT	DP	Y
6.10 Specify alpha	FT	DP	Y
6.12 Determine if useable historical data is available	*FT*	*AP*	*Y*
6.13 Specify data collection requirements	*FT*	*AP*	*Y*
Process Step 4: Collect Data			
6.14 Select the experimental units	*FT*	*AP*	*Y*
6.15 Record actual conditions under which data was collected	*FT*	*AP*	*N*
6.16 Collect and record data	*FT*	*AP*	*N*
6.17 Record deviations from specified conditions	*FT*	*AP*	*N*
Process Step 5: Perform Test			
6.18 Determine if data is normal	*FT*	*DP*	*Y*
6.28 Perform test	NT	AP	Y

LEGEND

AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 6: Summarize Test Results			
6.29 Summarize analysis	*FT*	*DP*	*Y*
Process Step 7: Apply Test Results to the Business Decision			
6.30 Apply statistical answer to statistical objective	*FT*	*DP*	*Y*
6.31 Apply answer from statistical objective to business objective	*FT*	*DP*	*Y*
6.32 Determine what action to take	*FT*	*DP*	*Y*
6.33 Implement action plan	*FT*	*AP*	*Y*
Process Step 8: Publish the Results			
6.34 Write the report	*FT*	*AP*	*Y*
6.35 Distribute the report	*NT*	*AP*	*N*

LEGEND

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FT = FAR TRANSFER
NT = NEAR TRANSFER

Regression

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 1: Define the Business Problem			
7.1 Write a problem statement	*FT*	*AP*	*Y*
7.2 Write an objective statement	*FT*	*AP*	*Y*
7.3 Determine if statistics will contribute to answering business problem	*FT*	*DP*	*Y*
Process Step 2: Select the Relevant Statistical Test			
7.4 Select type of evaluation	*FT*	*DP*	*Y*
7.5 Select distribution	*NT*	*DP*	*Y*
7.6 Select test	*FT*	*DP*	*Y*
7.7 Write business objective in statistical terms	*NT*	*AP*	*Y*
Process Step 3: Define Test Conditions			
7.9 State variables	FT	DP	Y
7.12 Determine if useable historical data is available	*FT*	*AP*	*Y*
7.13 Specify data collection requirements	*FT*	*AP*	*Y*
Process Step 4: Collect Data			
7.14 Select the experimental units	*FT*	*AP*	*Y*
7.15 Record actual conditions under which data was collected	*FT*	*AP*	*N*
7.16 Collect and record data	*FT*	*AP*	*N*
7.17 Record deviations from specified conditions	*FT*	*AP*	*N*
Process Step 5: Perform Test			
7.18 Determine if data is normal	*FT*	*DP*	*Y*
7.28 Perform test	NT	AP	Y

LEGEND
AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

TASK LIST	NT/FT	METHOD	DEFICIENT Y/N
Process Step 6: Summarize Test Results			
7.29 Summarize analysis	*FT*	*DP*	*Y*
Process Step 7: Apply Test Results to the Business Decision			
7.30 Apply statistical answer to statistical objective	*FT*	*DP*	*Y*
7.31 Apply answer from statistical objective to business objective	*FT*	*DP*	*Y*
7.32 Determine what action to take	*FT*	*DP*	*Y*
7.33 Implement action plan	*FT*	*AP*	*Y*
Process Step 8: Publish the Results			
7.34 Write the report	*FT*	*AP*	*Y*
7.35 Distribute the report	*NT*	*AP*	*N*

LEGEND

AP = ACTION PROCEDURE
DP = DECISION PROCEDURE
FT = FAR TRANSFER
NT = NEAR TRANSFER

Purpose of Level II Analysis:

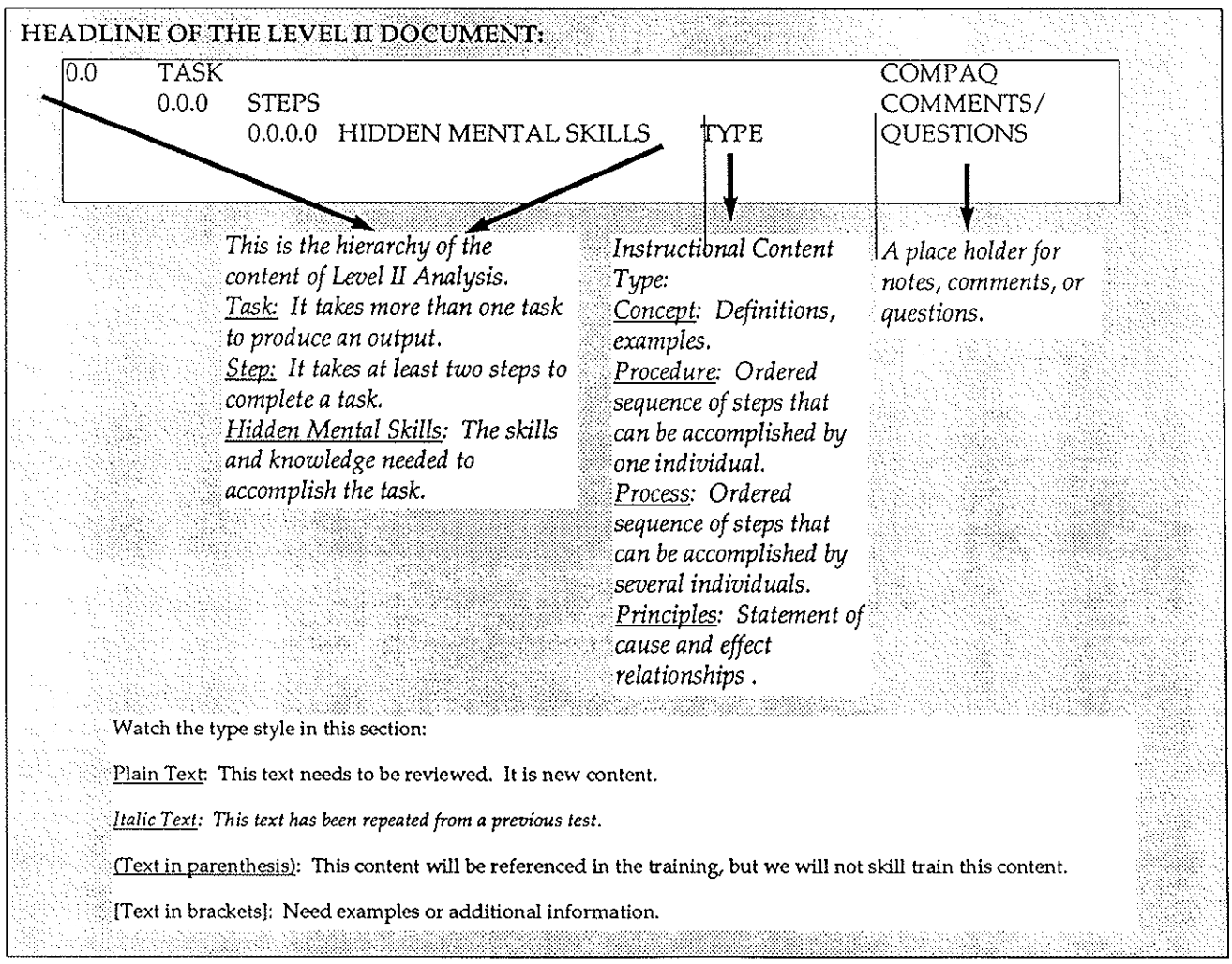
To define the steps and hidden mental skills for each of the tasks in a statistical test. There are seven statistical tests which are separated by red sheets. The seven statistical tests are:

1. Point Estimation/Confidence Intervals (Normal-Detailed)
2. Point Estimation/Confidence Intervals (Quick)
3. Point Estimation/Confidence Intervals (Binomial)
4. Point Estimation/Confidence Intervals (Poisson)
5. Hypothesis Testing (Normal-Detailed)
6. Correlation
7. Regression

Content Explanation

The first page behind each red sheet is a graphic representation of the content. It is meant to be used as a reference document to help keep you focused.

The content behind the matrix is arranged in a hierarchical fashion. An explanation is below.



Review for:

Statistical Tests

	This section is OK as is. It is complete and accurate.	This section needs work. Completeness Issue	Accuracy Issue
1. Point Estimation/Confidence Intervals (Normal-Detailed)	❑	❑	❑
2. Point Estimation/Confidence Intervals (Quick)	❑	❑	❑
3. Point Estimation/Confidence Intervals (Binomial)	❑	❑	❑
4. Point Estimation/Confidence Intervals (Poisson)	❑	❑	❑
5. Hypothesis Testing (Normal-Detailed)	❑	❑	❑
6. Correlation	❑	❑	❑
7. Regression	❑	❑	❑

Point Estimation/Confidence Intervals (Normal-Detailed)

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 1: Define the Business Problem		
1.1 Write a problem statement	Action Procedure	
1.1.1 Identify a business problem		
1.1.2 Brainstorm potential problem statements		
1.1.3 Draft the problem statement		
1.1.3.1 Definition of problem statement	Concept	
1.1.3.2 Guidelines to write a problem statement	Principles	
1.1.4 Evaluate the problem statement for clarity and completeness		
1.1.4.1 Guidelines for clarity and completeness	Principles	
1.2 Write an objective statement	Action Procedure	
1.2.1 Review the problem statement		
1.2.2 Brainstorm potential objectives		
1.2.3 Draft the objective in business terms		
1.2.3.1 Tools to help narrow objectives	Concept	
1.2.3.2 Definition of Pareto chart	Concept	
1.2.3.3 Definition of objective statement	Concept	
1.2.3.4 Guidelines to write an objective in business terms	Principles	
1.2.4 Evaluate the objective for clarity and completeness		
1.2.4.1 Guidelines for clarity and completeness	Principles	
1.3 Determine if statistics will contribute to answering the business problem	Decision Procedure	
1.3.1 Review the objective statement		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.3.2 Determine importance of the objective from a business perspective		
1.3.2.1 Issues to consider when determining importance	Concept	
1.3.2.2 Guidelines to prioritize issues	Principles	
1.3.3 Evaluate the risk of making a wrong decision		
1.3.3.1 How a wrong decision may impact business	Principles	
1.3.4 Determine possible cause of the problem		
1.3.4.1 Possible tools to determine cause	Concept	
1.3.4.2 Definition of cause and effect diagram	Concept	
1.3.5 Evaluate whether statistics will contribute to answering the business problem		
1.3.5.1 Why use statistics	Concept	
1.3.5.2 Definition of statistics	Concept	
1.3.5.3 Definition of descriptive and inferential statistics	Concept	
1.3.5.4 How SQE's use statistics	Principles	
1.3.6 If it does contribute to the answer, determine whether it is an effective/efficient use of resources		
1.3.6.1 Guidelines for evaluating use of resources	Principles	
Process Step 2: Select the Relevant Statistical Test		
1.4 Select type of evaluation	Decision Procedure	
1.4.1 Identify action to be taken		
1.4.1.1 What are the action types	Concept	
1.4.2 Identify number of groups to be examined		
1.4.2.1 Guidelines to determine how many groups	Principles	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.4.3 Identify type of test		
1.4.3.1 Definition of point estimation and confidence intervals	Concept	
1.4.3.2 Definition of hypothesis testing	Concept	
1.4.3.3 Definition of correlation and regression	Concept	
1.5 Select distribution	Decision Procedure	
1.5.1 Select the performance characteristic		
1.5.1.1 Definition of performance characteristic	Concept	
1.5.1.2 Guidelines for selecting performance characteristic	Principles	
1.5.2 Determine the type of data to be gathered		
1.5.2.1 Definition of a trial	Concept	
1.5.2.2 Possible outcomes of a single trial	Concept	
1.5.2.3 Characteristics of types of data	Concept	
1.5.2.4 Relationship between types of data and SPC	Principles	
1.5.3 Locate type of distribution		
1.5.3.1 Definition of probability distribution	Concept	
1.5.3.2 Characteristics of normal, binomial, and Poisson distribution	Concept	
1.5.3.3 Definition of skewness	Concept	
1.5.4 Select quick or detailed method		
1.5.4.1 Recognize the risks of either decision	Concept	
1.5.4.2 Guidelines to select one over the other	Principles	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.6 Select test	Decision Procedure	
1.6.1 Locate the Selecting the Relevant Statistical Test chart		
1.6.2 Follow the previous decisions to select the correct test		
1.6.3 Record test name on test worksheet		
1.7 Write business objective in statistical terms	Action Procedure	
1.7.1 Review the performance characteristic chosen		
1.7.2 Review the decisions made to select the correct test		
1.7.3 Write the statistical objective on the test worksheet		
1.7.3.1 Guidelines for writing the objective in statistical terms	Principles	
1.7.3.2 Location on worksheet	Concept	
Process Step 3: Define Test Conditions		
1.12 Determine if useable historical data is available	Decision Procedure	
1.12.1 Determine the sources of data		
1.12.1.1 Where to get data	Concept	
1.12.2 Determine if the data is useable		
1.12.2.1 Guidelines for useability	Principles	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.13 Specify data collection requirements	Action Procedure	
1.13.1 Specify population		
1.13.1.1 Definition of an experiment	Concept	
1.13.1.2 Definition of population and sample	Concept	
1.13.1.3 Definition of parameter and statistic	Concept	
1.13.1.4 Why sampling is important	Concept	
1.13.1.5 Definition of sample size	Concept	
1.13.1.6 Guidelines to specify population	Principles	
1.13.2 Record population description on data collection worksheet		
1.13.2.1 Location on worksheet	Concept	
1.13.3 Select sampling plan type and method		
1.13.3.1 Definition of experimental unit	Concept	
1.13.3.2 Definition of sampling plan types	Concept	
1.13.3.3 Definition of sampling methods	Concept	
1.13.3.4 Guidelines for selecting sampling methods	Principles	
1.13.4 Record sampling plan type and method on the data collection worksheet		
1.13.4.1 Location on worksheet	Concept	
1.13.5 Calculate sample size		
1.13.5.1 Recognize the importance of the correct sample size	Concept	
1.13.6 Record sample size on data collection worksheet		
1.13.6.1 Location on worksheet	Concept	
1.13.7 Determine experimental units		
1.13.7.1 Definition of experimental unit	Concept	
1.13.7.2 Definition of data point	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.13.8 Record experimental units on data collection worksheet		
1.13.8.1 Location on worksheet	Concept	
1.13.9 Specify conditions under which the data will be collected		
1.13.9.1 Guidelines to specify conditions	Principles	
1.13.9.2 What are the types of conditions to consider	Concept	
1.13.10 Record conditions on data collection worksheet		
1.13.10.1 Location on worksheet	Concept	
1.13.11 Specify measurement method		
1.13.11.1 What is a measurement	Concept	
1.13.11.2 What level of accuracy is needed	Concept	
1.13.12 Record measurement method on data collection worksheet		
1.13.12.1 Location on worksheet	Concept	
Process Step 4: Collect data		
1.14 Select the experimental units	Action Procedure	
1.14.1 Locate experimental units specified in the data collection worksheet		
1.14.1.1 Location on worksheet and in plant	Concept	
1.14.2 Take experimental units to assigned plant locations		
1.14.2.1 Where to take the units	Concept	
1.15 Record actual conditions under which data was collected	Action Procedure	
1.15.1 Observe actual conditions		
1.15.1.1 What are the conditions	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.15.2 Complete actual conditions column on data collection worksheet		
1.15.2.1 Location on the worksheet	Principles	
1.16 Collect and record data	Action Procedure	
1.16.1 Take measurements or count		
1.16.1.1 What is a measurement	Concept	
1.16.1.2 What level of accuracy is needed	Concept	
1.16.2 Complete data column on data location worksheet		
1.16.2.1 Location on worksheet	Concept	
1.17 Record deviations from specified conditions	Action Procedure	
1.17.1 Observe deviations		
1.17.1.1 Definition of deviation	Concept	
1.17.2 Complete deviations column on data collection worksheet		
1.17.2.1 Location on worksheet	Concept	
Process Step 5: Perform Test		
1.18 Determine if data is normal	Decision Procedure	
1.18.1 Plot the data on normal probability paper		
1.18.1.1 Definition of skewness	Concept	
1.18.1.2 Definition of normal probability paper	Concept	
1.18.2 Analyze outliers		
1.18.2.1 What is an outlier	Concept	
1.18.3 Interpret normal probability plot		
1.18.3.1 Guidelines for interpreting normal probability plot	Principles	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.18.4 Perform the test for skewness		
1.18.4.1 Definition of skewness	Concept	
1.18.4.2 Definition of alpha	Concept	
1.18.5 Interpret results		
1.18.5.1 Guidelines for interpreting normality	Principles	
1.18.5.2 Definition of central limit theorem	Concept	
1.18.6 Record decision on test worksheet		
1.18.6.1 Location on worksheet	Concept	
1.20 Calculate mean	Action Procedure	
1.20.1 Sum the data values		
1.20.1.1 Definition of measures of central tendency	Concept	
1.20.1.2 Definition of mean	Concept	
1.20.1.3 Guidelines for choosing the best estimator	Principles	
1.20.2 Divide the sum by sample size		
1.20.3 Record mean on test worksheet		
1.20.3.1 Location on worksheet	Concept	
1.24 Calculate standard deviation	Action Procedure	
1.24.1 Subtract the mean from each data value		
1.24.2 Square the value from the previous step		
1.24.3 Sum the value from the previous step		
1.24.4 Divide the sum by the sample size minus 1		
1.24.4.1 Definition of variance	Concept	
1.24.4.2 Definition of standard deviation	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.24.5 Record standard deviation on test worksheet		
1.24.5.1 Location on worksheet	Concept	
1.26 Specify level of confidence	Decision Procedure	
1.26.1 Determine level of confidence		
1.26.1.1 Guidelines for specifying level of confidence	Principles	
1.26.2 Record level of confidence on test worksheet		
1.26.2.1 Location on worksheet	Concept	
1.27 Calculate confidence interval	Action Procedure	
1.27.1 Specify an alpha level		
1.27.1.1 Definition of alpha	Concept	
1.27.2 Determine t value		
1.27.2.1 Characteristics of t distribution	Concept	
1.27.3 Record the confidence interval		
1.27.3.1 Location on worksheet	Concept	
Process Step 6: Summarize Test Results		
1.29 Summarize analysis	Decision Procedure	
1.29.1 Construct histogram		
1.29.1.1 Definition of frequency distribution	Concept	
1.29.1.2 Definition of a histogram	Concept	
1.29.1.3 When to use a histogram	Concept	
1.29.2 Locate the confidence interval on the test worksheet and record on summary document		
1.29.2.1 Location on worksheet	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.29.3 Do a common sense check on the test results		
1.29.3.1 Guidelines for completing a common sense check	Principles	
Process Step 7: Apply Test Results to the Business Decision		
1.30 Apply statistical answer to statistical objective	Decision Procedure	
1.30.1 Review original statistical objective		
1.30.2 Evaluate how the statistical results answer the statistical objective		
1.30.2.1 Guidelines for evaluation	Principles	
1.31 Apply answer from statistical objective to business objective	Decision Procedure	
1.31.1 Review original business objective and problem statement		
1.31.2 Evaluate how the answer to the statistical objective contributes to answering the business question		
1.31.2.1 Guidelines for evaluation	Principles	
1.32 Determine what action to take	Decision Procedure	
1.32.1 Identify possible actions		
1.32.1.1 What are the possible actions	Concept	
1.32.2 Select appropriate action		
1.32.2.1 Guidelines for selecting actions	Principles	
1.33 Implement action plan	Action Procedure	
1.33.1 Generate an action plan to accomplish the business objective		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
1.33.2 Monitor the action plan to completion		
Process Step 8: Publish the Results		
1.34 Write the report	Action Procedure	
1.34.1 Locate information from worksheets and reports generated in study		
1.34.1.1 What information to include	Concept	
1.34.1.2 Location on worksheet	Concept	
1.34.2 Generate a report		
1.34.2.1 What format to use	Concept	
1.35 Distribute the report	Action Procedure	
1.35.1 Identify recipients of report		
1.35.1.1 Guidelines to identify recipients	Principles	
1.35.2 Select distribution method		
1.35.2.1 What methods are available	Concept	

Point Estimation/Confidence Intervals (Quick)

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 1: Define the Business Problem		
2.1 Write a problem statement	*Action Procedure*	
2.1.1 Identify a business problem		
2.1.2 Brainstorm potential problem statements		
2.1.3 Draft the problem statement		
2.1.3.1 Definition of problem statement	*Concept*	
2.1.3.2 Guidelines to write a problem statement	*Principles*	
2.1.4 Evaluate the problem statement for clarity and completeness		
2.1.4.1 Guidelines for clarity and completeness	*Principles*	
2.2 Write an objective statement	*Action Procedure*	
2.2.1 Review the problem statement		
2.2.2 Brainstorm potential objectives		
2.2.3 Draft the objective in business terms		
2.2.3.1 Tools to help narrow objectives	*Concept*	
2.2.3.2 Definition of Pareto chart	*Concept*	
2.2.3.3 Definition of objective statement	*Concept*	
2.2.3.4 Guidelines to write an objective in business terms	*Principles*	
2.2.4 Evaluate the objective for clarity and completeness		
2.2.4.1 Guidelines for clarity and completeness	*Principles*	
2.3 Determine if statistics will contribute to answering the business problem	*Decision Procedure*	
2.3.1 Review the objective statement		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
2.3.2 Determine importance of the objective from a business perspective		
2.3.2.1 Issues to consider when determining importance	*Concept*	
2.3.2.2 Guidelines to prioritize issues	*Principles*	
2.3.3 Evaluate the risk of making a wrong decision		
2.3.3.1 How a wrong decision may impact business	*Principles*	
2.3.4 Determine possible cause of the problem		
2.3.4.1 Possible tools to determine cause	*Concept*	
2.3.4.2 Definition of cause and effect diagram	*Concept*	
2.3.5 Evaluate whether statistics will contribute to answering the business problem		
2.3.5.1 Why use statistics	*Concept*	
2.3.5.2 Definition of statistics	*Concept*	
2.3.5.3 Definition of descriptive and inferential statistics	*Concept*	
2.3.5.4 How SQE's use statistics	*Principles*	
2.3.6 If it does contribute to the answer, determine whether it is an effective/efficient use of resources		
2.3.6.1 Guidelines for evaluating use of resources	*Principles*	
Process Step 2: Select the Relevant Statistical Test		
2.4 Select type of evaluation	*Decision Procedure*	
2.4.1 Identify action to be taken		
2.4.1.1 What are the action types	*Concept*	
2.4.2 Identify number of groups to be examined		
2.4.2.1 Guidelines to determine how many groups	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
2.4.3 Identify type of test		
2.4.3.1 Definition of point estimation and confidence intervals	*Concept*	
2.4.3.2 Definition of hypothesis testing	*Concept*	
2.4.3.3 Definition of correlation and regression	*Concept*	
2.5 Select distribution	*Decision Procedure*	
2.5.1 Select the performance characteristic		
2.5.1.1 Definition of performance characteristic	*Concept*	
2.5.1.2 Guidelines for selecting performance characteristic	*Principles*	
2.5.2 Determine the type of data to be gathered		
2.5.2.1 Definition of a trial	*Concept*	
2.5.2.2 Possible outcomes of a single trial	*Concept*	
2.5.2.3 Characteristics of types of data	*Concept*	
2.5.2.4 Relationship between types of data and SPC	*Principles*	
2.5.3 Locate type of distribution		
2.5.3.1 Definition of probability distribution	*Concept*	
2.5.3.2 Characteristics of normal, binomial, and Poisson distribution	*Concept*	
2.5.3.3 Definition of skewness	*Concept*	
2.5.4 Select quick or detailed method		
2.5.4.1 Recognize the risks of either decision	*Concept*	
2.5.4.2 Guidelines to select one over the other	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
2.6 Select test	*Decision Procedure*	
2.6.1 Locate the Selecting the Relevant Statistical Test chart		
2.6.2 Follow the previous decisions to select the correct test		
2.6.3 Record test name on test worksheet		
2.7 Write business objective in statistical terms	*Action Procedure*	
2.7.1 Review the performance characteristic chosen		
2.7.2 Review the decisions made to select the correct test		
2.7.3 Write the statistical objective on the test worksheet		
2.7.3.1 Guidelines for writing the objective in statistical terms	*Principles*	
2.7.3.2 Location on worksheet	*Concept*	
Process Step 3: Define Test Conditions		
2.12 Determine if useable historical data is available	*Decision Procedure*	
2.12.1 Determine the sources of data		
2.12.1.1 Where to get data	*Concept*	
2.12.2 Determine if the data is useable		
2.12.2.1 Guidelines for useability	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
2.13 Specify data collection requirements	*Action Procedure*	
2.13.1 Specify population		
2.13.1.1 Definition of an experiment	*Concept*	
2.13.1.2 Definition of population and sample	*Concept*	
2.13.1.3 Definition of parameter and statistic	*Concept*	
2.13.1.4 Why sampling is important	*Concept*	
2.13.1.5 Definition of sample size	*Concept*	
2.13.1.6 Guidelines to specify population	*Principles*	
2.13.2 Record population description on data collection worksheet		
2.13.2.1 Location on worksheet	*Concept*	
2.13.3 Select sampling plan type and method		
2.13.3.1 Definition of experimental unit	*Concept*	
2.13.3.2 Definition of sampling plan types	*Concept*	
2.13.3.3 Definition of sampling methods	*Concept*	
2.13.3.4 Guidelines for selecting sampling methods	*Principles*	
2.13.4 Record sampling plan type and method on the data collection worksheet		
2.13.4.1 Location on worksheet	*Concept*	
2.13.5 Calculate sample size		
2.13.5.1 Recognize the importance of the correct sample size	*Concept*	
2.13.6 Record sample size on data collection worksheet		
2.13.6.1 Location on worksheet	*Concept*	
2.13.7 Determine experimental units		
2.13.7.1 Definition of experimental unit	*Concept*	
2.13.7.2 Definition of data point	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
2.13.8 Record experimental units on data collection worksheet		
2.13.8.1 Location on worksheet	*Concept*	
2.13.9 Specify conditions under which the data will be collected		
2.13.9.1 Guidelines to specify conditions	*Principles*	
2.13.9.2 What are the types of conditions to consider	*Concept*	
2.13.10 Record conditions on data collection worksheet		
2.13.10.1 Location on worksheet	*Concept*	
2.13.11 Specify measurement method		
2.13.11.1 What is a measurement	*Concept*	
2.13.11.2 What level of accuracy is needed	*Concept*	
2.13.12 Record measurement method on data collection worksheet		
2.13.12.1 Location on worksheet	*Concept*	
Process Step 4: Collect data		
2.14 Select the experimental units	*Action Procedure*	
2.14.1 Locate experimental units specified in the data collection worksheet		
2.14.1.1 Location on worksheet and in plant	*Concept*	
2.14.2 Take experimental units to assigned plant locations		
2.14.2.1 Where to take the units	*Concept*	
2.15 Record actual conditions under which data was collected	*Action Procedure*	
2.15.1 Observe actual conditions		
2.15.1.1 What are the conditions	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
2.15.2 Complete actual conditions column on data collection worksheet		
2.15.2.1 Location on the worksheet	*Principles*	
2.16 Collect and record data	*Action Procedure*	
2.16.1 Take measurements or count		
2.16.1.1 What is a measurement	*Concept*	
2.16.1.2 What level of accuracy is needed	*Concept*	
2.16.2 Complete data column on data location worksheet		
2.16.2.1 Location on worksheet	*Concept*	
2.17 Record deviations from specified conditions	*Action Procedure*	
2.17.1 Observe deviations		
2.17.1.1 Definition of deviation	*Concept*	
2.17.2 Complete deviations column on data collection worksheet		
2.17.2.1 Location on worksheet	*Concept*	
Process Step 5: Perform Test		
2.19 Determine if data is symmetrical	Decision Procedure	
2.19.1 Specify α level		
2.19.2 Perform calculations		
2.19.2.1 Definition of skewness	Concept	
2.19.2.2 Definition of alpha	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
2.21 Calculate median	Action Procedure	
2.21.1 Arrange sample data in order from smallest to largest		
2.21.1.1 Definition of median	Concept	
2.21.2 If the number of measurements is odd, the median is the middle; if the number of the measurements is even, add the two middle values and divide by 2.		
2.21.3 Record mean on test worksheet		
2.21.3.1 Location on worksheet	Concept	
2.25 Calculate quartile deviation	Action Procedure	
2.25.1 Calculate the first quartile (Q_1)		
2.25.2 Calculate the third quartile (Q_3)		
2.25.2.1 Definition of quartile class	Concept	
2.25.3 Compute the quartile deviation.		
2.25.3.1 Definition of quartile deviation	Concept	
2.26 Specify level of confidence	Decision Procedure	
2.26.1 Determine level of confidence		
2.26.1.1 Guidelines for specifying level of confidence	Principles	
2.26.2 Record level of confidence on test worksheet		
2.26.2.1 Location on worksheet	Concept	
2.27 Calculate confidence interval		
2.27.1 Specify an alpha level		
2.27.1.1 Definition of alpha	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
2.27.2 Find the upper endpoint value by finding an integer, Cα, from the table		
2.27.2.1 Definition of Cα	Concept	
2.27.3 Order the sample measurements from smallest to largest		
2.27.4 Using the Cα number, locate the sample measurement with that rank number		
2.27.5 Solve the formula: n-Cα+1		
2.27.6 Locate the sample measurement with this rank number		
2.27.7 Record the confidence interval		
2.27.7.1 Location on worksheet	Concept	
Process Step 6: Summarize Test Results		
2.29 Summarize analysis	*Decision Procedure*	
2.29.1 Construct histogram		
2.29.1.1 Definition of frequency distribution	*Concept*	
2.29.1.2 Definition of a histogram	*Concept*	
2.29.1.3 When to use a histogram	*Concept*	
2.29.2 Locate the confidence interval on the test worksheet and record on summary document		
2.29.2.1 Location on worksheet	*Concept*	
2.29.3 Do a common sense check on the test results		
2.29.3.1 Guidelines for completing a common sense check	Principles	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 7: Apply Test Results to the Business Decision		
2.30 Apply statistical answer to statistical objective	Decision Procedure	
2.30.1 Review original statistical objective		
2.30.2 Evaluate how the statistical results answer the statistical objective		
2.30.2.1 Guidelines for evaluation	Principles	
2.31 Apply answer from statistical objective to business objective	Decision Procedure	
2.31.1 Review original business objective and problem statement		
2.31.2 Evaluate how the answer to the statistical objective contributes to answering the business question		
2.31.2.1 Guidelines for evaluation	Principles	
2.32 Determine what action to take	Decision Procedure	
2.32.1 Identify possible actions		
2.32.1.1 What are the possible actions	Concept	
2.32.2 Select appropriate action		
2.32.2.1 Guidelines for selecting actions	Principles	
2.33 Implement action plan	Action Procedure	
2.33.1 Generate an action plan to accomplish the business objective		
2.33.2 Monitor the action plan to completion		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 8: Publish the Results		
2.34 Write the report	Action Procedure	
2.34.1 Locate information from worksheets and reports generated in study		
2.34.1.1 What information to include	Concept	
2.34.1.2 Location on worksheet	Concept	
2.34.2 Generate a report		
2.34.2.1 What format to use	Concept	
2.35 Distribute the report	Action Procedure	
2.35.1 Identify recipients of report		
2.35.1.1 Guidelines to identify recipients	Principles	
2.35.2 Select distribution method		
2.35.2.1 What methods are available	Concept	

Point Estimation/ Confidence Intervals (Binomial)

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
3.3.2 Determine importance of the objective from a business perspective		
3.3.2.1 Issues to consider when determining importance	*Concept*	
3.3.2.2 Guidelines to prioritize issues	*Principles*	
3.3.3 Evaluate the risk of making a wrong decision		
3.3.3.1 How a wrong decision may impact business	*Principles*	
3.3.4 Determine possible cause of the problem		
3.3.4.1 Possible tools to determine cause	*Concept*	
3.3.4.2 Definition of cause and effect diagram	*Concept*	
3.3.5 Evaluate whether statistics will contribute to answering the business problem		
3.3.5.1 Why use statistics	*Concept*	
3.3.5.2 Definition of statistics	*Concept*	
3.3.5.3 Definition of descriptive and inferential statistics	*Concept*	
3.3.5.4 How SQE's use statistics	*Principles*	
3.3.6 If it does contribute to the answer, determine whether it is an effective/efficient use of resources		
3.3.6.1 Guidelines for evaluating use of resources	*Principles*	
Process Step 2: Select the Relevant Statistical Test		
3.4 Select type of evaluation	*Decision Procedure*	
3.4.1 Identify action to be taken		
3.4.1.1 What are the action types	*Concept*	
3.4.2 Identify number of groups to be examined		
3.4.2.1 Guidelines to determine how many groups	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
3.4.3 Identify type of test		
3.4.3.1 Definition of point estimation and confidence intervals	*Concept*	
3.4.3.2 Definition of hypothesis testing	*Concept*	
3.4.3.3 Definition of correlation and regression	*Concept*	
3.5 Select distribution	*Decision Procedure*	
3.5.1 Select the performance characteristic		
3.5.1.1 Definition of performance characteristic	*Concept*	
3.5.1.2 Guidelines for selecting performance characteristic	*Principles*	
3.5.2 Determine the type of data to be gathered		
3.5.2.1 Definition of a trial	*Concept*	
3.5.2.2 Possible outcomes of a single trial	*Concept*	
3.5.2.3 Characteristics of types of data	*Concept*	
3.5.2.4 Relationship between types of data and SPC	*Principles*	
3.5.3 Locate type of distribution		
3.5.3.1 Definition of probability distribution	*Concept*	
3.5.3.2 Characteristics of normal, binomial, and Poisson distribution	*Concept*	
3.5.3.3 Definition of skewness	*Concept*	
3.6 Select test	*Decision Procedure*	
3.6.1 Locate the Selecting the Relevant Statistical Test chart		
3.6.2 Follow the previous decisions to select the correct test		
3.6.3 Record test name on test worksheet		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
3.7 Write business objective in statistical terms	*Action Procedure*	
3.7.1 Review the performance characteristic chosen		
3.7.2 Review the decisions made to select the correct test		
3.7.3 Write the statistical objective on the test worksheet		
3.7.3.1 Guidelines for writing the objective in statistical terms	*Principles*	
3.7.3.2 Location on worksheet	*Concept*	
Process Step 3: Define Test Conditions		
3.12 Determine if useable historical data is available	*Decision Procedure*	
3.12.1 Determine the sources of data		
3.12.1.1 Where to get data	*Concept*	
3.12.2 Determine if the data is useable		
3.12.2.1 Guidelines for useability	*Principles*	
3.13 Specify data collection requirements	*Action Procedure*	
3.13.1 Specify population		
3.13.1.1 Definition of an experiment	*Concept*	
3.13.1.2 Definition of population and sample	*Concept*	
3.13.1.3 Definition of parameter and statistic	*Concept*	
3.13.1.4 Why sampling is important	*Concept*	
3.13.1.5 Definition of sample size	*Concept*	
3.13.1.6 Guidelines to specify population	*Principles*	
3.13.2 Record population description on data collection worksheet		
3.13.2.1 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
3.13.3 Select sampling plan type and method		
3.13.3.1 Definition of experimental unit	*Concept*	
3.13.3.2 Definition of sampling plan types	*Concept*	
3.13.3.3 Definition of sampling methods	*Concept*	
3.13.3.4 Guidelines for selecting sampling methods	*Principles*	
3.13.4 Record sampling plan type and method on the data collection worksheet		
3.13.4.1 Location on worksheet	*Concept*	
3.13.5 Calculate sample size		
3.13.5.1 Recognize the importance of the correct sample size	*Concept*	
3.13.6 Record sample size on data collection worksheet		
3.13.6.1 Location on worksheet	*Concept*	
3.13.7 Determine experimental units		
3.13.7.1 Definition of experimental unit	*Concept*	
3.13.7.2 Definition of data point	*Concept*	
3.13.8 Record experimental units on data collection worksheet		
3.13.8.1 Location on worksheet	*Concept*	
3.13.9 Specify conditions under which the data will be collected		
3.13.9.1 Guidelines to specify conditions	*Principles*	
3.13.9.2 What are the types of conditions to consider	*Concept*	
3.13.10 Record conditions on data collection worksheet		
3.13.10.1 Location on worksheet	*Concept*	
3.13.11 Specify measurement method		
3.13.11.1 What is a measurement	Concept	
3.13.12 Record measurement method on data collection worksheet		
3.13.12.1 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 4: Collect data		
3.14 Select the experimental units	*Action Procedure*	
3.14.1 Locate experimental units specified in the data collection worksheet		
3.14.1.1 Location on worksheet and in plant	*Concept*	
3.14.2 Take experimental units to assigned plant locations		
3.14.2.1 Where to take the units	*Concept*	
3.15 Record actual conditions under which data was collected	*Action Procedure*	
3.15.1 Observe actual conditions		
3.15.1.1 What are the conditions	*Concept*	
3.15.2 Complete actual conditions column on data collection worksheet		
3.15.2.1 Location on the worksheet	*Principles*	
3.16 Collect and record data	*Action Procedure*	
3.16.1 Take count		
3.16.2 Complete data column on data location worksheet		
3.16.2.1 Location on worksheet	*Concept*	
3.17 Record deviations from specified conditions	*Action Procedure*	
3.17.1 Observe deviations		
3.17.1.1 Definition of deviation	*Concept*	
3.17.2 Complete deviations column on data collection worksheet		
3.17.2.1 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 5: Perform Test		
3.22 Calculate *p*	*Action Procedure*	
3.22.1 Divide the number of successes by the sample size		
3.22.1.1 Definition of *p*	*Concept*	
3.22.2 Record *p* on test worksheet		
3.22.2.1 Location on worksheet	*Concept*	
3.26 Specify level of confidence	*Decision Procedure*	
3.26.1 Determine level of confidence		
3.26.1.1 Guidelines for specifying level of confidence	*Principles*	
3.26.2 Record level of confidence on test worksheet		
3.26.2.1 Location on worksheet	*Concept*	
3.27 Calculate confidence interval		
3.27.1 Specify an alpha level		
3.27.1.1 Definition of alpha	*Concept*	
3.27.2 Calculate end points using the Z table		
3.27.1 Characteristics of Z distribution	Concept	
3.27.3 Record the confidence interval		
3.27.3.1 Location on worksheet	*Concept*	
Process Step 6: Summarize Test Results		
3.29 Summarize analysis	*Decision Procedure*	
3.29.1 Construct line graph		
3.28.1.1 Definition of line graph	Csoncept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
3.29.2 Locate the confidence interval on the test worksheet and record on summary document		
3.29.2.1 Location on worksheet	*Concept*	
3.29.3 Do a common sense check on the test results		
3.29.3.1 Guidelines for completing a common sense check	*Principles*	
Process Step 7: Apply Test Results to the Business Decision		
3.30 Apply statistical answer to statistical objective	*Decision Procedure*	
3.30.1 Review original statistical objective		
3.30.2 Evaluate how the statistical results answer the statistical objective		
3.30.2.1 Guidelines for evaluation	*Principles*	
3.31 Apply answer from statistical objective to business objective	*Decision Procedure*	
3.31.1 Review original business objective and problem statement		
3.31.2 Evaluate how the answer to the statistical objective contributes to answering the business question		
3.31.2.1 Guidelines for evaluation	*Principles*	
3.32 Determine what action to take	*Decision Procedure*	
3.32.1 Identify possible actions		
3.32.1.1 What are the possible actions	*Concept*	
3.32.2 Select appropriate action		
3.32.2.1 Guidelines for selecting actions	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
3.33 Implement action plan	*Action Procedure*	
3.33.1 Generate an action plan to accomplish the business objective		
3.33.2 Monitor the action plan to completion		
Process Step 8: Publish the Results		
3.34 Write the report	*Action Procedure*	
3.34.1 Locate information from worksheets and reports generated in study		
3.34.1.1 What information to include	*Concept*	
3.34.1.2 Location on worksheet	*Concept*	
3.34.2 Generate a report		
3.34.2.1 What format to use	*Concept*	
3.35 Distribute the report	*Action Procedure*	
3.35.1 Identify recipients of report		
3.35.1.1 Guidelines to identify recipients	*Principles*	
3.35.2 Select distribution method		
3.35.2.1 What methods are available	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 1: Define the Business Problem		
4.1 Write a problem statement	*Action Procedure*	
4.1.1 Identify a business problem		
4.1.2 Brainstorm potential problem statements		
4.1.3 Draft the problem statement		
4.1.3.1 Definition of problem statement	*Concept*	
4.1.3.2 Guidelines to write a problem statement	*Principles*	
4.1.4 Evaluate the problem statement for clarity and completeness		
4.1.4.1 Guidelines for clarity and completeness	*Principles*	
4.2 Write an objective statement	*Action Procedure*	
4.2.1 Review the problem statement		
4.2.2 Brainstorm potential objectives		
4.2.3 Draft the objective in business terms		
4.2.3.1 Tools to help narrow objectives	*Concept*	
4.2.3.2 Definition of Pareto chart	*Concept*	
4.2.3.3 Definition of objective statement	*Concept*	
4.2.3.4 Guidelines to write an objective in business terms	*Principles*	
4.2.4 Evaluate the objective for clarity and completeness		
4.2.4.1 Guidelines for clarity and completeness	*Principles*	
4.3 Determine if statistics will contribute to answering the business problem	*Decision Procedure*	
4.3.1 Review the objective statement		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
4.3.2 Determine importance of the objective from a business perspective		
4.3.2.1 Issues to consider when determining importance	*Concept*	
4.3.2.2 Guidelines to prioritize issues	*Principles*	
4.3.3 Evaluate the risk of making a wrong decision		
4.3.3.1 How a wrong decision may impact business	*Principles*	
4.3.4 Determine possible cause of the problem		
4.3.4.1 Possible tools to determine cause	*Concept*	
4.3.4.2 Definition of cause and effect diagram	*Concept*	
4.3.5 Evaluate whether statistics will contribute to answering the business problem		
4.3.5.1 Why use statistics	*Concept*	
4.3.5.2 Definition of statistics	*Concept*	
4.3.5.3 Definition of descriptive and inferential statistics	*Concept*	
4.3.5.4 How SQE's use statistics	*Principles*	
4.3.6 If it does contribute to the answer, determine whether it is an effective/efficient use of resources		
4.3.6.1 Guidelines for evaluating use of resources	*Principles*	
Process Step 2: Select the Relevant Statistical Test		
4.4 Select type of evaluation	*Decision Procedure*	
4.4.1 Identify action to be taken		
4.4.1.1 What are the action types	*Concept*	
4.4.2 Identify number of groups to be examined		
4.4.2.1 Guidelines to determine how many groups	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
4.4.3 Identify type of test		
4.4.3.1 Definition of point estimation and confidence intervals	*Concept*	
4.4.3.2 Definition of hypothesis testing	*Concept*	
4.4.3.3 Definition of correlation and regression	*Concept*	
4.5 Select distribution	*Decision Procedure*	
4.5.1 Select the performance characteristic		
4.5.1.1 Definition of performance characteristic	*Concept*	
4.5.1.2 Guidelines for selecting performance characteristic	*Principles*	
4.5.2 Determine the type of data to be gathered		
4.5.2.1 Definition of a trial	*Concept*	
4.5.2.2 Possible outcomes of a single trial	*Concept*	
4.5.2.3 Characteristics of types of data	*Concept*	
4.5.2.4 Relationship between types of data and SPC	*Principles*	
4.5.3 Locate type of distribution		
4.5.3.1 Definition of probability distribution	*Concept*	
4.5.3.2 Characteristics of normal, binomial, and Poisson distribution	*Concept*	
4.5.3.3 Definition of skewness	*Concept*	
4.6 Select test	*Decision Procedure*	
4.6.1 Locate the Selecting the Relevant Statistical Test chart		
4.6.2 Follow the previous decisions to select the correct test		
4.6.3 Record test name on test worksheet		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
4.7 Write business objective in statistical terms	*Action Procedure*	
4.7.1 Review the performance characteristic chosen		
4.7.2 Review the decisions made to select the correct test		
4.7.3 Write the statistical objective on the test worksheet		
4.7.3.1 Guidelines for writing the objective in statistical terms	*Principles*	
4.7.3.2 Location on worksheet	*Concept*	
Process Step 3: Define Test Conditions		
4.12 Determine if useable historical data is available	*Decision Procedure*	
4.12.1 Determine the sources of data		
4.12.1.1 Where to get data	*Concept*	
4.12.2 Determine if the data is useable		
4.12.2.1 Guidelines for useability	*Principles*	
4.13 Specify data collection requirements	*Action Procedure*	
4.13.1 Specify population		
4.13.1.1 Definition of an experiment	*Concept*	
4.13.1.2 Definition of population and sample	*Concept*	
4.13.1.3 Definition of parameter and statistic	*Concept*	
4.13.1.4 Why sampling is important	*Concept*	
4.13.1.5 Definition of sample size	*Concept*	
4.13.1.6 Guidelines to specify population	*Principles*	
4.13.2 Record population description on data collection worksheet		
4.13.2.1 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
4.13.3 Select sampling plan type and method		
4.13.3.1 Definition of experimental unit	*Concept*	
4.13.3.2 Definition of sampling plan types	*Concept*	
4.13.3.3 Definition of sampling methods	*Concept*	
4.13.3.4 Guidelines for selecting sampling methods	*Principles*	
4.13.4 Record sampling plan type and method on the data collection worksheet		
4.13.4.1 Location on worksheet	*Concept*	
4.13.5 Determine sample size		
4.13.5.1 Recognize the importance of the correct sample size	*Concept*	
4.13.6 Record sample size on data collection worksheet		
4.13.6.1 Location on worksheet	*Concept*	
4.13.7 Determine experimental units		
4.13.7.1 Definition of experimental unit	*Concept*	
4.13.7.2 Definition of data point	*Concept*	
4.13.8 Record experimental units on data collection worksheet		
4.13.8.1 Location on worksheet	*Concept*	
4.13.9 Specify conditions under which the data will be collected		
4.13.9.1 Guidelines to specify conditions	*Principles*	
4.13.9.2 What are the types of conditions to consider	*Concept*	
4.13.10 Record conditions on data collection worksheet		
4.13.10.1 Location on worksheet	*Concept*	
4.13.11 Specify measurement method		
4.13.11.1 What is a measurement	*Concept*	
4.13.12 Record measurement method on data collection worksheet		
4.13.12.1 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 4: Collect data		
4.14 Select the experimental units	*Action Procedure*	
4.14.1 Locate experimental units specified in the data collection worksheet		
4.14.1.1 Location on worksheet and in plant	*Concept*	
4.14.2 Take experimental units to assigned plant locations		
4.14.2.1 Where to take the units	*Concept*	
4.15 Record actual conditions under which data was collected	*Action Procedure*	
4.15.1 Observe actual conditions		
4.15.1.1 What are the conditions	*Concept*	
4.15.2 Complete actual conditions column on data collection worksheet		
4.15.2.1 Location on the worksheet	*Principles*	
4.16 Collect and record data	*Action Procedure*	
4.16.1 Take count		
4.16.2 Complete data column on data location worksheet		
4.16.2.1 Location on worksheet	*Concept*	
4.17 Record deviations from specified conditions	*Action Procedure*	
4.17.1 Observe deviations		
4.17.1.1 Definition of deviation	*Concept*	
4.17.2 Complete deviations column on data collection worksheet		
4.17.2.1 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 5: Perform Test		
4.23 Calculate *c*	Action Procedure	
4.23.1 Divide the number of successes by the number of units or unit of time		
4.23.1.1 Definition of *c*	Concept	
4.23.1.2 Definition of successes	Concept	
4.23.2 Record *c* on test worksheet		
4.23.2.1 Location on worksheet	Concept	
4.26 Specify level of confidence	*Decision Procedure*	
4.26.1 Determine level of confidence		
4.26.1.1 Guidelines for specifying level of confidence	*Principles*	
4.26.2 Record level of confidence on test worksheet		
4.26.2.1 Location on worksheet	*Concept*	
4.27 Calculate confidence interval		
4.27.1 Locate level of confidence and the corresponding Y on the chart		
4.27.2 Substitute the *c* value and the Y value into the formula and solve		
4.27.3 Record the confidence interval		
4.27.3.1 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 6: Summarize Test Results		
4.29 Summarize analysis	*Decision Procedure*	
4.29.1 Construct a frequency distribution, bar chart, or pie chart.		
4.29.1.1 Steps to construct a frequency distribution	Concept	
4.29.1.2 Definition of frequency distribution	Concept	
4.29.1.3 Steps to construct bar chart	Concept	
4.29.1.4 Definition of bar chart	Concept	
4.29.1.5 Steps to construct pie chart	Concept	
4.29.1.6 Definition of a pie chart	Concept	
4.29.2 Locate the confidence interval on the test worksheet and record on summary document		
4.29.2.1 Location on worksheet	*Concept*	
4.29.3 Do a common sense check on the test results		
4.29.3.1 Guidelines for completing a common sense check	*Principles*	
Process Step 7: Apply Test Results to the Business Decision		
4.30 Apply statistical answer to statistical objective	*Decision Procedure*	
4.30.1 Review original statistical objective		
4.30.2 Evaluate how the statistical results answer the statistical objective		
4.30.2.1 Guidelines for evaluation	*Principles*	
4.31 Apply answer from statistical objective to business objective	*Decision Procedure*	
4.31.1 Review original business objective and problem statement		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
4.31.2 Evaluate how the answer to the statistical objective contributes to answering the business question		
4.31.2.1 Guidelines for evaluation	*Principles*	
4.32 Determine what action to take	*Decision Procedure*	
4.32.1 Identify possible actions		
4.32.1.1 What are the possible actions	*Concept*	
4.32.2 Select appropriate action		
4.32.2.1 Guidelines for selecting actions	*Principles*	
4.33 Implement action plan	*Action Procedure*	
4.33.1 Generate an action plan to accomplish the business objective		
4.33.2 Monitor the action plan to completion		
Process Step 8: Publish the Results		
4.34 Write the report	*Action Procedure*	
4.34.1 Locate information from worksheets and reports generated in study		
4.34.1.1 What information to include	*Concept*	
4.34.1.2 Location on worksheet	*Concept*	
4.34.2 Generate a report		
4.34.2.1 What format to use	*Concept*	
4.35 Distribute the report	*Action Procedure*	
4.35.1 Identify recipients of report		
4.35.1.1 Guidelines to identify recipients	*Principles*	
4.35.2 Select distribution method		
4.35.2.1 What methods are available	*Concept*	

Hypothesis Testing
(Normal-Detailed)

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 1: Define the Business Problem		
5.1 Write a problem statement	*Action Procedure*	
5.1.1 Identify a business problem		
5.1.2 Brainstorm potential problem statements		
5.1.3 Draft the problem statement		
5.1.3.1 Definition of problem statement	*Concept*	
5.1.3.2 Guidelines to write a problem statement	*Principles*	
5.1.4 Evaluate the problem statement for clarity and completeness		
5.1.4.1 Guidelines for clarity and completeness	*Principles*	
5.2 Write an objective statement	*Action Procedure*	
5.2.1 Review the problem statement		
5.2.2 Brainstorm potential objectives		
5.2.3 Draft the objective in business terms		
5.2.3.1 Tools to help narrow objectives	*Concept*	
5.2.3.2 Definition of Pareto chart	*Concept*	
5.2.3.3 Definition of objective statement	*Concept*	
5.2.3.4 Guidelines to write an objective in business terms	*Principles*	
5.2.4 Evaluate the objective for clarity and completeness		
5.2.4.1 Guidelines for clarity and completeness	*Principles*	
5.3 Determine if statistics will contribute to answering the business problem	*Decision Procedure*	
5.3.1 Review the objective statement		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
5.3.2 Determine importance of the objective from a business perspective		
5.3.2.1 Issues to consider when determining importance	*Concept*	
5.3.2.2 Guidelines to prioritize issues	*Principles*	
5.3.3 Evaluate the risk of making a wrong decision		
5.3.3.1 How a wrong decision may impact business	*Principles*	
5.3.4 Determine possible cause of the problem		
5.3.4.1 Possible tools to determine cause	*Concept*	
5.3.4.2 Definition of cause and effect diagram	*Concept*	
5.3.5 Evaluate whether statistics will contribute to answering the business problem		
5.3.5.1 Why use statistics	*Concept*	
5.3.5.2 Definition of statistics	*Concept*	
5.3.5.3 Definition of descriptive and inferential statistics	*Concept*	
5.3.5.4 How SQE's use statistics	*Principles*	
5.3.6 If it does contribute to the answer, determine whether it is an effective/efficient use of resources		
5.3.6.1 Guidelines for evaluating use of resources	*Principles*	
Process Step 2: Select the Relevant Statistical Test		
5.4 Select type of evaluation	*Decision Procedure*	
5.4.1 Identify action to be taken		
5.4.1.1 What are the action types	*Concept*	
5.4.2 Identify number of groups to be examined		
5.4.2.1 Guidelines to determine how many groups	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
5.4.3 Identify type of test		
5.4.3.1 Definition of point estimation and confidence intervals	*Concept*	
5.4.3.2 Definition of hypothesis testing	*Concept*	
5.4.3.3 Definition of correlation and regression	*Concept*	
5.5 Select distribution	*Decision Procedure*	
5.5.1 Select the performance characteristic		
5.5.1.1 Definition of performance characteristic	*Concept*	
5.5.1.2 Guidelines for selecting performance characteristic	*Principles*	
5.5.2 Determine the type of data to be gathered		
5.5.2.1 Definition of a trial	*Concept*	
5.5.2.2 Possible outcomes of a single trial	*Concept*	
5.5.2.3 Characteristics of types of data	*Concept*	
5.5.2.4 Relationship between types of data and SPC	*Principles*	
5.5.3 Locate type of distribution		
5.5.3.1 Definition of probability distribution	*Concept*	
5.5.3.2 Characteristics of normal, binomial, and Poisson distribution	*Concept*	
5.5.3.3 Definition of skewness	*Concept*	
5.5.4 Select quick or detailed method		
5.5.4.1 Recognize the risks of either decision	*Concept*	
5.5.4.2 Guidelines to select one over the other	*Principles*	
5.6 Select test	*Decision Procedure*	
5.6.1 Locate the Selecting the Relevant Statistical Test chart		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
5.6.2 Follow the previous decisions to select the correct test		
5.6.3 Record test name on test worksheet		
5.7 Write business objective in statistical terms	*Action Procedure*	
5.7.1 Review the performance characteristic chosen		
5.7.2 Review the decisions made to select the correct test		
5.7.3 Write the statistical objective on the test worksheet		
5.7.3.1 Guidelines for writing the objective in statistical terms	*Principles*	
5.7.3.2 Location on worksheet	*Concept*	
Process Step 3: Define Test Conditions		
5.8 State the null with an equal sign	Decision Procedure	
5.8.1 State the null with an equal sign		
5.8.1.1 Definition of null hypothesis	Concept	
5.8.1.2 Description of one sample t test	Concept	
5.8.2 Select one of the three alternative hypotheses		
5.8.2.1 Definition of alternative hypothesis	Concept	
5.8.3 Record null and alternative hypothesis on test worksheet		
5.8.3.1 Location on worksheet	Concept	
5.10 Specify alpha		
5.10.1 Choose an alpha level		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
5.10.1.1 Definition of alpha	Concept	
5.10.1.2 Guidelines to choose alpha	Principles	
5.10.2 For a two-tailed test, divide alpha by 2		
5.10.2.1 Definition of a two-tailed test	Concept	
5.11 Specify beta	Action Procedure	
5.11.1 Choose a beta level		
5.11.1.1 Definition of beta	Concept	
5.11.1.2 Guideline to choose beta	Principles	
5.11.1.3 Description of how alpha and beta level affect each other	Concept	
5.11.2 Record beta level on test worksheet		
5.11.2.1 Location on worksheet	Concept	
5.12 Determine if useable historical data is available	*Decision Procedure*	
5.12.1 Determine the sources of data		
5.12.1.1 Where to get data	*Concept*	
5.12.2 Determine if the data is useable		
5.12.2.1 Guidelines for useability	*Principles*	
5.13 Specify data collection requirements	*Decision Procedure*	
5.13.1 Specify population		
5.13.1.1 Definition of an experiment	*Concept*	
5.13.1.2 Definition of population and sample	*Concept*	
5.13.1.3 Definition of parameter and statistic	*Concept*	
5.13.1.4 Why sampling is important	*Concept*	
5.13.1.5 Definition of sample size	*Concept*	
5.13.1.6 Guidelines to specify population	*Principles*	
5.13.2 Record population description on data collection worksheet		
5.13.2.1 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
5.13.3 Select sampling plan type and method		
5.13.3.1 Definition of experimental unit	*Concept*	
5.13.3.2 Definition of sampling plan types	*Concept*	
5.13.3.3 Definition of sampling methods	*Concept*	
5.13.3.4 Guidelines for selecting sampling methods	*Principles*	
5.13.4 Record sampling plan type and method on the data collection worksheet		
5.13.4.1 Location on worksheet	*Concept*	
5.13.5 Calculate sample size		
5.13.5.1 Recognize the importance of the correct sample size	Concept	
5.13.6 Record sample size on data collection worksheet		
5.13.6.1 Location on worksheet	*Concept*	
5.13.7 Determine experimental units		
5.13.7.1 Definition of experimental unit	*Concept*	
5.13.7.2 Definition of data point	*Concept*	
5.13.8 Record experimental units on data collection worksheet		
5.13.8.1 Location on worksheet	*Concept*	
5.13.9 Specify conditions under which the data will be collected		
5.13.9.1 Guidelines to specify conditions	*Principles*	
5.13.9.2 What are the types of conditions to consider	*Concept*	
5.13.10 Record conditions on data collection worksheet		
5.13.10.1 Location on worksheet	*Concept*	
5.13.11 Specify measurement method		
5.13.11.1 What is a measurement	*Concept*	
5.13.11.2 What level of accuracy is needed	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
5.13.12 Record measurement method on data collection worksheet		
5.13.12.1 Location on worksheet	*Concept*	
Process Step 4: Collect data		
5.14 Select the experimental units	*Action Procedure*	
5.14.1 Locate experimental units specified in the data collection worksheet		
5.14.1.1 Location on worksheet and in plant	*Concept*	
5.14.2 Take experimental units to assigned plant locations		
5.14.2.1 Where to take the units	*Concept*	
5.15 Record actual conditions under which data was collected	*Action Procedure*	
5.15.1 Observe actual conditions		
5.15.1.1 What are the conditions	*Concept*	
5.15.2 Complete actual conditions column on data collection worksheet		
5.15.2.1 Location on the worksheet	*Concept*	
5.16 Collect and record data	*Action Procedure*	
5.16.1 Take measurements or count		
5.16.1.1 What is a measurement	*Concept*	
5.16.1.2 What level of accuracy is needed	*Concept*	
5.16.2 Complete data column on data location worksheet		
5.16.2.1 Location on worksheet	*Concept*	
5.17 Record deviations from specified conditions	*Action Procedure*	
5.17.1 Observe deviations		
5.17.1.1 Definition of deviation	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
5.17.2 Complete deviations column on data collection worksheet		
5.17.2.1 Location on worksheet	*Concept*	
Process Step 5: Perform Test		
5.18 Determine if data is normal	*Action Procedure*	
5.18.1 Plot the data on normal probability paper		
5.18.1.1 Definition of skewness	*Concept*	
5.18.1.2 Definition of normal probability paper	*Concept*	
5.18.2 Analyze outliers		
5.18.2.1 What is an outlier	*Concept*	
5.18.3 Interpret normal probability plot		
5.18.3.1 Guidelines for interpreting normal probability plot	*Principles*	
5.18.4 Perform the test for skewness		
5.18.4.1 Definition of skewness	*Concept*	
5.18.4.2 Definition of alpha	*Concept*	
5.18.5 Interpret results		
5.18.5.1 Guidelines for interpreting normality	*Principles*	
5.18.5.2 Definition of central limit theorem	*Concept*	
5.18.6 Record decision on test worksheet		
5.18.6.1 Location on worksheet	*Concept*	
5.28 Perform test		
5.28.1 Calculate descriptive statistics		
5.28.1.1 Definition of measures of central tendency	*Concept*	
5.28.1.2 Definition of mean	*Concept*	
5.28.1.3 Definition of variance	*Concept*	
5.28.1.4 Definition of standard deviation	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
5.28.2 Record mean and standard deviation on test worksheet		
5.28.2.1 Location on worksheet	Concept	
5.28.3 Calculate test statistic		
5.28.4 Record on test worksheet		
5.28.4.1 Location on worksheet	Concept	
5.28.5 Compare calculated statistics to table value		
5.28.5.1 Characteristics of t distribution	*Concept*	
5.28.6 Reject or do not reject null		
5.28.6.1 Guidelines for making decision	*Principles*	
5.28.7 Record decision on test worksheet		
5.28.7.1 Location on worksheet	Concept	
Process Step 6: Summarize Test Results		
5.29 Summarize analysis	*Decision Procedure*	
5.29.1 Construct histogram		
5.29.1.1 Definition of frequency distribution	*Concept*	
5.29.1.2 Definition of a histogram	*Concept*	
5.29.1.3 When to use a histogram	*Concept*	
5.29.2 Locate the descriptive and test statistics on the test worksheet and record on summary document		
5.29.2.1 Location on worksheet	*Concept*	
5.29.3 Do a common sense check on the test results		
5.29.3.1 Guidelines for completing a common sense check	Principles	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 7: Apply Test Results to the Business Decision		
5.30 Apply statistical answer to statistical objective	*Decision Procedure*	
5.30.1 Review original statistical objective		
5.30.2 Evaluate how the statistical results answer the statistical objective		
5.30.2.1 Guidelines for evaluation	*Principles*	
5.31 Apply answer from statistical objective to business objective		
5.31.1 Review original business objective and problem statement		
5.31.2 Evaluate how the answer to the statistical objective contributes to answering the business question		
5.31.2.1 Guidelines for evaluation	*Principles*	
5.32 Determine what action to take		
5.32.1 Identify possible actions		
5.32.1.1 What are the possible actions	*Concept*	
5.32.2 Select appropriate action		
5.32.2.1 Guidelines for selecting actions	*Principles*	
5.33 Implement action plan		
5.33.1 Generate an action plan to accomplish the business objective		
5.33.2 Monitor the action plan to completion		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 8: Publish the Results		
5.34 Write the report	*Action Procedure*	
5.34.1 Locate information from worksheets and reports generated in study		
5.34.1.1 What information to include	*Concept*	
5.34.1.2 Location on worksheet	*Concept*	
5.34.2 Generate a report	*Concept*	
5.34.2.1 What format to use		
5.35 Distribute the report	*Action Procedure*	
5.35.1 Identify recipients of report		
5.35.1.1 Guidelines to identify recipients	*Principles*	
5.35.2 Select distribution method		
5.35.2.1 What methods are available	*Concept*	

Correlation

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 1: Define the Business Problem		
6.1 Write a problem statement	*Action Procedure*	
6.1.1 Identify a business problem		
6.1.2 Brainstorm potential problem statements		
6.1.3 Draft the problem statement		
6.1.3.1 Definition of problem statement	*Concept*	
6.1.3.2 Guidelines to write a problem statement	*Principles*	
6.1.4 Evaluate the problem statement for clarity and completeness		
6.1.4.1 Guidelines for clarity and completeness	*Principles*	
6.2 Write an objective statement	*Action Procedure*	
6.2.1 Review the problem statement		
6.2.2 Brainstorm potential objectives		
6.2.3 Draft the objective in business terms		
6.2.3.1 Tools to help narrow objectives	*Concept*	
6.2.3.2 Definition of Pareto chart	*Concept*	
6.2.3.3 Definition of objective statement	*Concept*	
6.2.3.4 Guidelines to write an objective in business terms	*Principles*	
6.2.4 Evaluate the objective for clarity and completeness		
6.2.4.1 Guidelines for clarity and completeness	*Principles*	
6.3 Determine if statistics will contribute to answering the business problem	*Decision Procedure*	
6.3.1 Review the objective statement		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
6.3.2 Determine importance of the objective from a business perspective		
6.3.2.1 Issues to consider when determining importance	*Concept*	
6.3.2.2 Guidelines to prioritize issues	*Principles*	
6.3.3 Evaluate the risk of making a wrong decision		
6.3.3.1 How a wrong decision may impact business	*Principles*	
6.3.4 Determine possible cause of the problem		
6.3.4.1 Possible tools to determine cause	*Concept*	
6.3.4.2 Definition of cause and effect diagram	*Concept*	
6.3.5 Evaluate whether statistics will contribute to answering the business problem		
6.3.5.1 Why use statistics	*Concept*	
6.3.5.2 Definition of statistics	*Concept*	
6.3.5.3 Definition of descriptive and inferential statistics	*Concept*	
6.3.5.4 How SQE's use statistics	*Principles*	
6.3.6 If it does contribute to the answer, determine whether it is an effective/efficient use of resources		
6.3.6.1 Guidelines for evaluating use of resources	*Principles*	
Process Step 2: Select the Relevant Statistical Test		
6.4 Select type of evaluation	*Decision Procedure*	
6.4.1 Identify action to be taken		
6.4.1.1 What are the action types	*Concept*	
6.4.2 Identify number of groups to be examined		
6.4.2.1 Guidelines to determine how many groups	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
6.4.3 Identify type of test		
6.4.3.1 Definition of point estimation and confidence intervals	*Concept*	
6.4.3.2 Definition of hypothesis testing	*Concept*	
6.4.3.3 Definition of correlation and regression	*Concept*	
6.5 Select distribution	*Decision Procedure*	
6.5.1 Select the performance characteristics for the two variables		
6.5.1.1 Definition of performance characteristic	*Concept*	
6.5.1.2 Guidelines for selecting performance characteristic	*Principles*	
6.5.2 Determine the type of data to be gathered		
6.5.2.1 Definition of a trial	*Concept*	
6.5.2.2 Possible outcomes of a single trial	*Concept*	
6.5.2.3 Characteristics of types of data	*Concept*	
6.5.2.4 Relationship between types of data and SPC	*Principles*	
6.5.3 Locate type of distribution		
6.5.3.1 Definition of probability distribution	*Concept*	
6.5.3.2 Characteristics of normal, binomial, and Poisson distribution	*Concept*	
6.5.3.3 Definition of skewness	*Concept*	
6.5.4 Select quick or detailed method		
6.5.4.1 Recognize the risks of either decision	*Concept*	
6.5.4.2 Guidelines to select one over the other	*Principles*	
6.6 Select test	*Decision Procedure*	
6.6.1 Locate the Selecting the Relevant Statistical Test chart		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
6.6.2 Follow the previous decisions to select the correct test		
6.6.3 Record test name on test worksheet		
6.7 Write business objective in statistical terms	*Action Procedure*	
6.7.1 Review the performance characteristic chosen		
6.7.2 Review the decisions made to select the correct test		
6.7.3 Write the statistical objective on the test worksheet		
6.7.3.1 Guidelines for writing the objective in statistical terms	*Principles*	
6.7.3.2 Location on worksheet	*Concept*	
Process Step 3: Define Test Conditions		
6.8 State the null and alternative hypothesis	Decision Procedure	
6.8.1 State null with an equal sign		
6.8.1.1 Definition of null hypotheses	Concept	
6.8.2 Select one of the three alternative hypotheses		
6.8.2.1 Definition of alternative hypothesis	Concept	
6.8.2.2 What are the choices	Concept	
6.9 State variables	Decision Procedure	
6.9.1 Review performance characteristic chosen for the two variables		
6.9.2 Record description of the two variables on test worksheet		
6.9.2.1 Location on worksheet	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
6.10 Specify alpha	Decision Procedure	
6.10.1 Choose an alpha level		
6.10.1.1 Definition of alpha	Concept	
6.10.1.2 Guidelines to choose alpha	Principles	
6.110.2 For a two-tailed test, divide alpha by 2		
6.10.2.1 Definition of a two-tailed test	Concept	
6.12 Determine if useable historical data is available	*Decision Procedure*	
6.12.1 Determine the sources of data		
6.12.1.1 Where to get data	*Concept*	
6.12.2 Determine if the data is useable		
6.12.2.1 Guidelines for useability	*Principles*	
6.13 Specify data collection requirements	*Decision Procedure*	
6.13.1 Specify population		
6.13.1.1 Definition of an experiment	*Concept*	
6.13.1.2 Definition of population and sample	*Concept*	
6.13.1.3 Definition of parameter and statistic	*Concept*	
6.13.1.4 Why sampling is important	*Concept*	
6.13.1.5 Definition of sample size	*Concept*	
6.13.1.6 Guidelines to specify population	*Principles*	
6.13.2 Record population description on data collection worksheet		
6.13.2.1 Location on worksheet	*Concept*	
6.13.3 Select sampling plan type and method		
6.13.3.1 Definition of experimental unit	*Concept*	
6.13.3.2 Definition of sampling plan types	*Concept*	
6.13.3.3 Definition of sampling methods	*Concept*	
6.13.3.4 Guidelines for selecting sampling methods	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
6.13.4 Record sampling plan type and method on the data collection worksheet		
6.13.4.1 Location on worksheet	*Concept*	
6.13.5 Determine sample size		
6.13.5.1 Recognize the importance of the correct sample size	Concept	
6.13.6 Record sample size on data collection worksheet		
6.13.6.1 Location on worksheet	*Concept*	
6.13.7 Determine experimental units		
6.13.7.1 Definition of experimental unit	*Concept*	
6.13.7.2 Definition of data point	*Concept*	
6.13.8 Record experimental units on data collection worksheet		
6.13.8.1 Location on worksheet	*Concept*	
6.13.9 Specify conditions under which the data will be collected		
6.13.9.1 Guidelines to specify conditions	*Principles*	
6.13.9.2 What are the types of conditions to consider	*Concept*	
6.13.10 Record conditions on data collection worksheet		
6.13.10.1 Location on worksheet	*Concept*	
6.13.11 Specify measurement method		
6.13.11.1 What is a measurement	*Concept*	
6.13.11.2 What level of accuracy is needed	*Concept*	
6.13.12 Record measurement method on data collection worksheet		
6.13.12.1 Location on worksheet	*Concept*	
Process Step 4: Collect data		
6.14 Select the experimental units	*Action Procedure*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
6.14.1 Locate experimental units specified in the data collection worksheet		
6.14.1.1 Location on worksheet and in plant	*Concept*	
6.14.2 Take experimental units to assigned plant locations		
6.14.2.1 Where to take the units	*Concept*	
6.15 Record actual conditions under which data was collected	*Action Procedure*	
6.15.1 Observe actual conditions		
6.15.1.1 What are the conditions	*Concept*	
6.15.2 Complete actual conditions column on data collection worksheet		
6.15.2.1 Location on the worksheet	*Concept*	
6.16 Collect and record data	*Action Procedure*	
6.16.1 Take measurements or count		
6.16.1.1 What is a measurement	*Concept*	
6.16.1.2 What level of accuracy is needed	*Concept*	
6.16.2 Complete data column on data location worksheet		
6.16.2.1 Location on worksheet	*Concept*	
6.17 Record deviations from specified conditions	*Action Procedure*	
6.17.1 Observe deviations		
6.17.1.1 Definition of deviation	*Concept*	
6.17.2 Complete deviations column on data collection worksheet		
6.17.2.1 Location on worksheet	*Concept*	
Process Step 5: Perform Test		
6.18 Determine if data is normal	*Action Procedure*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
6.18.1 Plot the data on normal probability paper		
6.18.1.1 Definition of skewness	*Concept*	
6.18.1.2 Definition of normal probability paper	*Concept*	
6.18.2 Analyze outliers		
6.18.2.1 What is an outlier	*Concept*	
6.18.3 Interpret normal probability plot		
6.18.3.1 Guidelines for interpreting normal probability plot	*Principles*	
6.18.4 Perform the test for skewness		
6.18.4.1 Definition of skewness	*Concept*	
6.18.4.2 Definition of alpha	*Concept*	
6.18.5 Interpret results		
6.18.5.1 Guidelines for interpreting normality	*Principles*	
6.18.5.2 Definition of central limit theorem	*Concept*	
6.18.6 Record decision on test worksheet		
6.18.6.1 Location on worksheet	*Concept*	
6.28 Perform test	Action Procedure	
6.28.1 Calculate descriptive statistics		
6.28.1.1 Definition of measures of central tendency	*Concept*	
6.28.1.2 Definition of mean	*Concept*	
6.28.1.3 Definition of variance	*Concept*	
6.28.1.4 Definition of standard deviation	*Concept*	
6.28.2 Record mean and standard deviation on test worksheet		
6.28.2.1 Location on worksheet	*Concept*	
6.28.3 Construct scatter diagram		
6.28.3.1 Definition of scatter diagram	Concept	
6.28.4 Calculate r		
6.28.4.1 Definition of r	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
6.30.2 Evaluate how the statistical results answer the statistical objective		
6.30.2.1 Guidelines for evaluation	Principles	
6.31 Apply answer from statistical objective to business objective		
6.31.1 Review original business objective and problem statement		
6.31.2 Evaluate how the answer to the statistical objective contributes to answering the business question		
6.31.2.1 Guidelines for evaluation	*Principles*	
6.32 Determine what action to take		
6.32.1 Identify possible actions		
6.32.1.1 What are the possible actions	*Concept*	
6.32.2 Select appropriate action		
6.32.2.1 Guidelines for selecting actions	*Principles*	
6.33 Implement action plan		
6.33.1 Generate an action plan to accomplish the business objective		
6.33.2 Monitor the action plan to completion		
Process Step 8: Publish the Results		
6.34 Write the report	*Action Procedure*	
6.34.1 Locate information from worksheets and reports generated in study		
6.34.1.1 What information to include	*Concept*	
6.34.1.2 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
6.34.2 Generate a report	*Concept*	
6.34.2.1 What format to use		
6.35 Distribute the report	*Action Procedure*	
6.35.1 Identify recipients of report		
6.35.1.1 Guidelines to identify recipients	*Principles*	
6.35.2 Select distribution method		
6.35.2.1 What methods are available	*Concept*	

Regression

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 1: Define the Business Problem		
7.1 Write a problem statement	*Action Procedure*	
7.1.1 Identify a business problem		
7.1.2 Brainstorm potential problem statements		
7.1.3 Draft the problem statement		
7.1.3.1 Definition of problem statement	*Concept*	
7.1.3.2 Guidelines to write a problem statement	*Principles*	
7.1.4 Evaluate the problem statement for clarity and completeness		
7.1.4.1 Guidelines for clarity and completeness	*Principles*	
7.2 Write an objective statement	*Action Procedure*	
7.2.1 Review the problem statement		
7.2.2 Brainstorm potential objectives		
7.2.3 Draft the objective in business terms		
7.2.3.1 Tools to help narrow objectives	*Concept*	
7.2.3.2 Definition of Pareto chart	*Concept*	
7.2.3.3 Definition of objective statement	*Concept*	
7.2.3.4 Guidelines to write an objective in business terms	*Principles*	
7.2.4 Evaluate the objective for clarity and completeness		
7.2.4.1 Guidelines for clarity and completeness	*Principles*	
7.3 Determine if statistics will contribute to answering the business problem	*Decision Procedure*	
7.3.1 Review the objective statement		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
7.3.2 Determine importance of the objective from a business perspective		
7.3.2.1 Issues to consider when determining importance	*Concept*	
7.3.2.2 Guidelines to prioritize issues	*Principles*	
7.3.3 Evaluate the risk of making a wrong decision		
7.3.3.1 How a wrong decision may impact business	*Principles*	
7.3.4 Determine possible cause of the problem		
7.3.4.1 Possible tools to determine cause	*Concept*	
7.3.4.2 Definition of cause and effect diagram	*Concept*	
7.3.5 Evaluate whether statistics will contribute to answering the business problem		
7.3.5.1 Why use statistics	*Concept*	
7.3.5.2 Definition of statistics	*Concept*	
7.3.5.3 Definition of descriptive and inferential statistics	*Concept*	
7.3.5.4 How SQE's use statistics	*Principles*	
7.3.6 If it does contribute to the answer, determine whether it is an effective/efficient use of resources		
7.3.6.1 Guidelines for evaluating use of resources	*Principles*	
Process Step 2: Select the Relevant Statistical Test		
7.4 Select type of evaluation	*Decision Procedure*	
7.4.1 Identify action to be taken		
7.4.1.1 What are the action types	*Concept*	
7.4.2 Identify number of groups to be examined		
7.4.2.1 Guidelines to determine how many groups	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
7.4.3 Identify type of test		
7.4.3.1 Definition of point estimation and confidence intervals	*Concept*	
7.4.3.2 Definition of hypothesis testing	*Concept*	
7.4.3.3 Definition of correlation and regression	*Concept*	
7.5 Select distribution	*Decision Procedure*	
7.5.1 Select the performance characteristics for the independent and dependent variables		
7.5.1.1 Definition of performance characteristic	*Concept*	
7.5.1.2 Definition of independent and dependent variables	Concept	
7.5.1.3 Guidelines for selecting performance characteristic	*Principles*	
7.5.2 Determine the type of data to be gathered		
7.5.2.1 Definition of a trial	*Concept*	
7.5.2.2 Possible outcomes of a single trial	*Concept*	
7.5.2.3 Characteristics of types of data	*Concept*	
7.5.2.4 Relationship between types of data and SPC	*Principles*	
7.5.3 Locate type of distribution		
7.5.3.1 Definition of probability distribution	*Concept*	
7.5.3.2 Characteristics of normal, binomial, and Poisson distribution	*Concept*	
7.5.3.3 Definition of skewness	*Concept*	
7.5.4 Select quick or detailed method		
7.5.4.1 Recognize the risks of either decision	*Concept*	
7.5.4.2 Guidelines to select one over the other	*Principles*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
7.6 Select test	*Decision Procedure*	
7.6.1 Locate the Selecting the Relevant Statistical Test chart		
7.6.2 Follow the previous decisions to select the correct test		
7.6.3 Record test name on test worksheet		
7.7 Write business objective in statistical terms	*Action Procedure*	
7.7.1 Review the performance characteristic chosen		
7.7.2 Review the decisions made to select the correct test		
7.7.3 Write the statistical objective on the test worksheet		
7.7.3.1 Guidelines for writing the objective in statistical terms	*Principles*	
7.7.3.2 Location on worksheet	*Concept*	
Process Step 3: Define Test Conditions		
7.9 State independent and dependent variables	Decision Procedure	
7.9.1 Review performance characteristic chosen		
7.9.2 Record independent and dependent variables on worksheet		
7.9.2.1 Location on worksheet	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
7.12 Determine if useable historical data is available	*Decision Procedure*	
7.12.1 Determine the sources of data		
7.12.1.1 Where to get data	*Concept*	
7.12.2 Determine if the data is useable		
7.12.2.1 Guidelines for useability	*Principles*	
7.13 Specify data collection requirements	*Decision Procedure*	
7.13.1 Specify population		
7.13.1.1 Definition of an experiment	*Concept*	
7.13.1.2 Definition of population and sample	*Concept*	
7.13.1.3 Definition of parameter and statistic	*Concept*	
7.13.1.4 Why sampling is important	*Concept*	
7.13.1.5 Definition of sample size	*Concept*	
7.13.1.6 Guidelines to specify population	*Principles*	
7.13.2 Record population description on data collection worksheet		
7.13.2.1 Location on worksheet	*Concept*	
7.13.3 Select sampling plan type and method		
7.13.3.1 Definition of experimental unit	*Concept*	
7.13.3.2 Definition of sampling plan types	*Concept*	
7.13.3.3 Definition of sampling methods	*Concept*	
7.13.3.4 Guidelines for selecting sampling methods	*Principles*	
7.13.4 Record sampling plan type and method on the data collection worksheet		
7.13.4.1 Location on worksheet	*Concept*	
7.13.5 Determine sample size		
7.13.5.1 Recognize the importance of the correct sample size	*Concept*	
7.13.6 Record sample size on data collection worksheet		
7.13.6.1 Location on worksheet	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
7.13.7 Determine experimental units		
7.13.7.1 Definition of experimental unit	*Concept*	
7.13.7.2 Definition of data point	*Concept*	
7.13.8 Record experimental units on data collection worksheet		
7.13.8.1 Location on worksheet	*Concept*	
7.13.9 Specify conditions under which the data will be collected		
7.13.9.1 Guidelines to specify conditions	*Principles*	
7.13.9.2 What are the types of conditions to consider	*Concept*	
7.13.10 Record conditions on data collection worksheet		
7.13.10.1 Location on worksheet	*Concept*	
7.13.11 Specify measurement method for the independent and dependent variable		
7.13.11.1 What is a measurement	*Concept*	
7.13.11.2 What level of accuracy is needed	*Concept*	
7.13.12 Record measurement method on data collection worksheet		
7.13.12.1 Location on worksheet	*Concept*	
Process Step 4: Collect data		
7.14 Select the experimental units	*Action Procedure*	
7.14.1 Locate experimental units specified in the data collection worksheet		
7.14.1.1 Location on worksheet and in plant	*Concept*	
7.14.2 Take experimental units to assigned plant locations		
7.14.2.1 Where to take the units	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
7.15 Record actual conditions under which data was collected	*Action Procedure*	
7.15.1 Observe actual conditions		
7.15.1.1 What are the conditions	*Concept*	
7.15.2 Complete actual conditions column on data collection worksheet		
7.15.2.1 Location on the worksheet	*Concept*	
7.16 Collect and record data	*Action Procedure*	
7.16.1 Take measurements or count		
7.16.1.1 What is a measurement	*Concept*	
7.16.1.2 What level of accuracy is needed	*Concept*	
716.2 Complete data column on data location worksheet		
7.16.2.1 Location on worksheet	*Concept*	
7.17 Record deviations from specified conditions	*Action Procedure*	
7.17.1 Observe deviations		
7.17.1.1 Definition of deviation	*Concept*	
7.17.2 Complete deviations column on data collection worksheet		
7.17.2.1 Location on worksheet	*Concept*	
Process Step 5: Perform Test		
7.18 Determine if data is normal	*Action Procedure*	
7.18.1 Plot the data on normal probability paper		
7.18.1.1 Definition of skewness	*Concept*	
7.18.1.2 Definition of normal probability paper	*Concept*	
7.18.2 Analyze outliers		
7.18.2.1 What is an outlier	*Concept*	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
7.18.3 Interpret normal probability plot		
7.18.3.1 Guidelines for interpreting normal probability plot	*Principles*	
7.18.4 Perform the test for skewness		
7.18.4.1 Definition of skewness	*Concept*	
7.18.4.2 Definition of alpha	*Concept*	
7.18.5 Interpret results		
7.18.5.1 Guidelines for interpreting normality	*Principles*	
7.18.5.2 Definition of central limit theorem	*Concept*	
7.18.6 Record decision on test worksheet		
7.18.6.1 Location on worksheet	*Concept*	
7.28 Perform test	Action Procedure	
7.28.1 Calculate descriptive statistics		
7.28.1.1 Definition of measures of central tendency	*Concept*	
7.28.1.2 Definition of mean	*Concept*	
7.28.1.3 Definition of variance	*Concept*	
7.28.1.4 Definition of standard deviation	*Concept*	
7.28.2 Record mean and standard deviation on test worksheet		
7.28.2.1 Location on worksheet	*Concept*	
7.28.3 Select the potential model for the regression equation		
7.28.3.1 Definition of regression equation	Concept	
7.28.3.2 Definition of method of least squares	Concept	
7.28.3.3 Description of uses for the regression equation	Concept	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
7.28.4 Check how well the model fits the data and modify the model as needed		
7.28.4.1 Definition of a scatter diagram	*Concept*	
7.28.4.2 Guidelines for evaluating a residual scatter diagram	Principles	
7.28.4.3 Definition of r^2	Concept	
7.28.4.4 Guidelines to evaluate r^2	Principles	
7.28.5 Use regression equation to generate predicted y values, if needed		
7.28.6 Record r^2 and regression equation on test worksheet		
7.28.6.1 Location on worksheet	Concept	
Process Step 6: Summarize Test Results		
7.29 Summarize analysis	*Decision Procedure*	
7.29.1 Locate the scatter diagram on the test worksheet and put a copy into summary document		
7.29.2 Locate r^2 and regression equation on the test worksheet and record on summary document		
7.29.2.1 Location on worksheet	*Concept*	
7.29.3 Do a common sense check on the test results		
7.29.3.1 Guidelines for completing a common sense check	Principles	

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 7: Apply Test Results to the Business Decision		
7.30 Apply statistical answer to statistical objective	*Decision Procedure*	
7.30.1 Review original statistical objective		
7.30.2 Evaluate how the statistical results answer the statistical objective		
7.30.2.1 Guidelines for evaluation	Principles	
7.31 Apply answer from statistical objective to business objective	*Decision Procedure*	
7.31.1 Review original business objective and problem statement		
7.31.2 Evaluate how the answer to the statistical objective contributes to answering the business question		
7.31.2.1 Guidelines for evaluation	Principles	
7.32 Determine what action to take	*Decision Procedure*	
7.32.1 Identify possible actions		
7.32.1.1 What are the possible actions	*Concept*	
7.32.2 Select appropriate action		
7.32.2.1 Guidelines for selecting actions	*Principles*	
7.33 Implement action plan	*Action Procedure*	
7.33.1 Generate an action plan to accomplish the business objective		
7.33.2 Monitor the action plan to completion		

0.0 TASK 0.0.0 STEPS 0.0.0.0 HIDDEN MENTAL SKILLS	TYPE	COMPAQ COMMENTS/ QUESTIONS
Process Step 8: Publish the Results		
7.34 Write the report	*Action Procedure*	
7.34.1 Locate information from worksheets and reports generated in study		
7.34.1.1 What information to include	*Concept*	
7.34.1.2 Location on worksheet	*Concept*	
7.34.2 Generate a report		
7.34.2.1 What format to use	*Concept*	
7.35 Distribute the report	*Action Procedure*	
7.35.1 Identify recipients of report		
7.35.1.1 Guidelines to identify recipients	*Principles*	
7.35.2 Select distribution method		
7.35.2.1 What methods are available	*Concept*	

For the Level III Analysis Document, refer to the Data I - Volume 2 Analysis Document.

TRAINING RECOMMENDATIONS

Terminal Objective: To increase the decision making effectiveness of the SQEs through correct selection and application of statistical tests.

Data I will cover knowledge and application level content for statistical tests. The statistical tests will be learned within a data driven decision making business process. The scope of the training will cover all four Point Estimation/Confidence Interval tests to the application level. Hypothesis testing, Correlation, and Regression will be introduced and a strong relationship between the Data I and Data II courses will be established.

Length of Course: Prior to design, our best estimate will be a minimum of 16 hours. The design document will specify the length.

Amount of Practice/Presentation Goal: 2/3 practice, 1/3 presentation

Amount of Help Aids: Several job aids will be developed to facilitate learning. Identified in the analysis: infrequent use of the more difficult tests, access to multiple statistical procedures, criticality of output, amount of potential large volume of data, and the number of far transfer tasks.

Course Design: The design of the course will be modular, in sections no longer than 4 hours.

Content to Train within the Data Driven Business Process (in order, from the Needs Assessment):

***1	Choosing the correct statistical test *This was identified as critical in the Needs Assessment Document. The data on page 11-4 suggests we need to increase the emphasis of this task. (See Select the Relevant Statistical Test - 12%)*	
2	Statistical software	
3	Nonparametric	*Note: Numbers 2 - 5 are going to be covered to the application level in Data II, and to a knowledge level in Data I.*
4	Hypothesis Testing	
5	Chi Square	
6	Attribute, variable, discrete, continuous	*Note: From 6 down will be covered to a knowledge and application level in Data I, as it relates to a statistical test. Concepts will wrap around application. Lots of mini-workshops.*
6	Point estimation	
6	Probability	
6	Independent and dependent event	
7	How to collect data	
8	Correlation	
8	Skewness	
9	Regression	
10	Poisson	
10	Sampling methods	
10	Confidence Intervals	
11	Variance	
12	Binomial	
13	Standard Deviation	
14	Distribution	
15	Mean, median, mode, average - when to use and the differences	
16	Charts (bar, pie, histogram, Pareto)	

Statistical Tests to Train:

1	Binomial
2	Chi Square test for binomial proportion (Two or more samples)
***2	*One-sample t test*
2	Two-sample t test
3	F test
4	Multiple Regression
5	One-way ANOVA
5	Two-way ANOVA
5	Curvilinear Regression
5	Chi Square for binomial
5	Chi Square test for binomial proportion (one-sample)
6	Linear Regression
7	Wilcoxon Rank Sum
7	Kruskal-Wallis
8	Correlation
9	Wilcoxon Signed Rank
9	Spearman

Note: Only One-sample t test will be covered briefly in the Data I course; the rest are application level in Data II.

Facilitator Guide:

This is an initial layout

PROMPT	TEXT	TIME	KEY POINTS
ICON	Text	Time	Items to stress

Participant Guide:

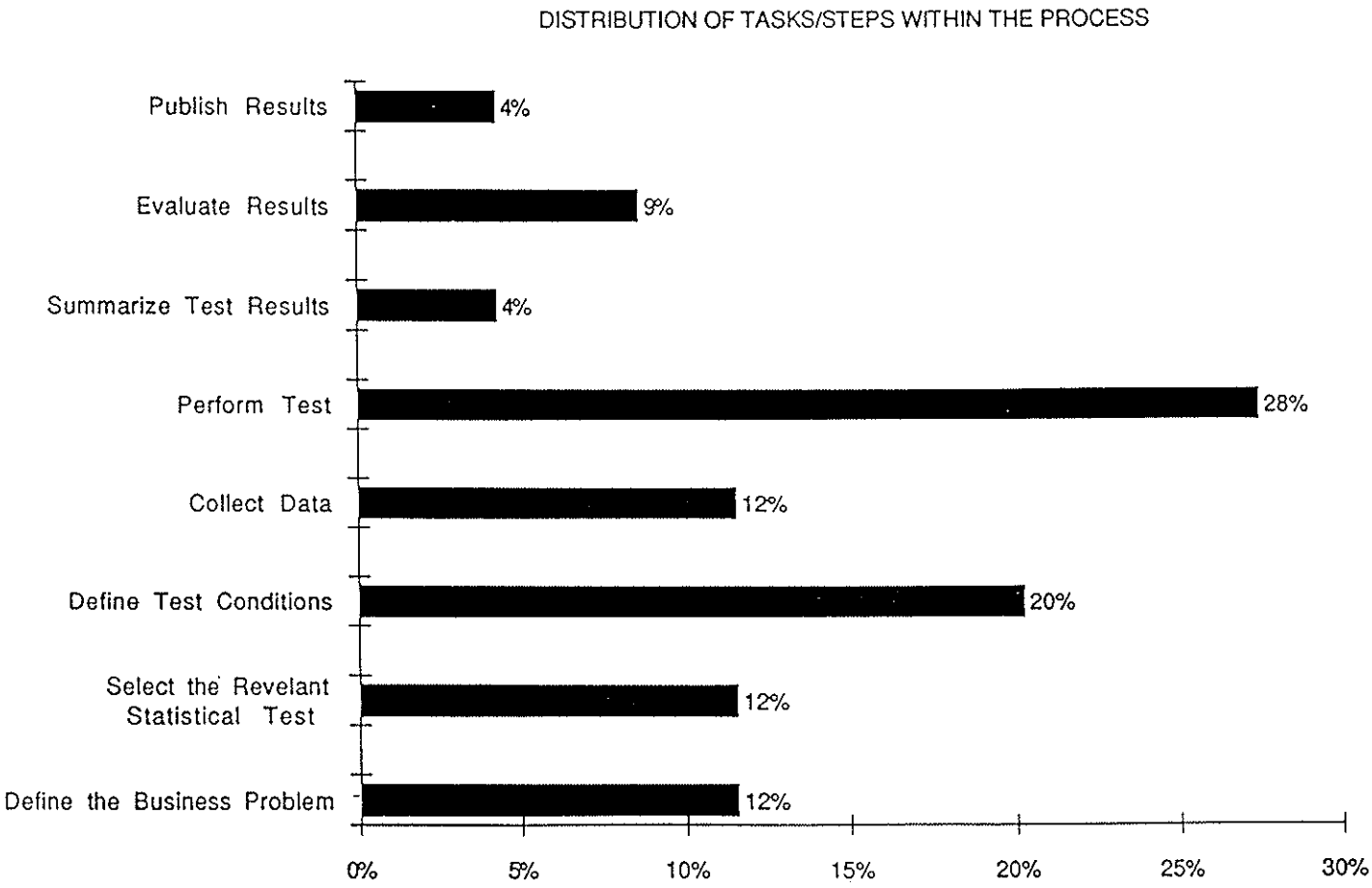
The layout of the remaining materials will be provided in the Design Document.

Software:

This is a key issue and careful thought needs to be given as to the results in the Needs Assessment. (See page 11-4.)

PROCESS AND TASK DISTRIBUTION

This graphic represents the process (vertical axis) and the percent tasks identified to date within the process. The Needs Assessment results suggest increasing "Select the Relevant Statistical Test" which would lead to an increase in "Summarize Test Results."



TRAINING RECOMMENDATIONS

ISSUES THAT WERE SURFACED - PENDING ITEMS

1. Software should be included as an integral part of the training in the classroom. There are several associated issues: responding to the needs of the target population, software recommendation vs. mandate, software in the classroom. Preliminary decisions indicate that BBN RS-1 and SAS statistical software will be used in classroom practices. Classes will be grouped so that all students will be either RS-1 or SAS and will have practices tailored for that software. This will double the development time for preparing practices and help aids.

2. The logistics of going through the CBT SAS or RS-1 training program prior to the Data I course needs to be considered. Questions: Will be made available to students; who will pay/monitor?

3. Is the Plan-Do-Check-Act model applicable to this model?

4. Content on rules of probability and areas under the normal curve do not directly apply to the statistical tests being taught. They should be considered for inclusion in a separate course or integrated into an existing course.

NONTRAINING RECOMMENDATIONS

Question 9 on the Needs Assessment document rank ordered with1 being the most common reason why people don't use statistics.

Training will take care of this:

1. Lack of training - we would like to do it, but we don't know how

Training will not take care of this:

2. Lack of resources, not enough manpower or equipment
3. Lack of time - not enough time with current workloads
4. Lack of equipment or tools; there are not enough available
5. Lack of motivation - our staff doesn't see the benefits of using statistics
6. Lack of feedback
7. Lack of customer support - customers do not see this as a priority
8. Lack of management support - management does not see this as a priority
8.. No one is asking us to use statistics in our department
9. Statistics are not needed in our department

APPENDIX A

NEEDS ASSESSMENT PRELIMINARY RESULTS DATA

The preliminary results data has been included. This document is the result of a hand count; previous count errors have been corrected and are so noted with a 12/3 update.

The Needs Assessments results have been entered into a database and can be sorted by any number of ways. If additional information or sorts are required, please contact Laurie.

APPENDIX B
DEFINITIONS

An effort has been made to generate common definitions. This glossary will be continuously updated throughout the development effort. Please revise any definitions as necessary for review with the team.

Alpha Risk (α) - The probability of erroneously rejecting the null hypothesis.

Alternative Hypothesis - Hypothesis of difference. (The accepted hypothesis if the null hypothesis is disproven.)

ANOVA - Analysis of Variance is a statistical technique which tests different factor levels for significant effects by partitioning observed variation. (Data II definition)

Attribute Data - Data that comes from qualitative (nonmeasurable) characteristics which can be counted. Attribute data is usually gathered in the form of nonconforming units or nonconformities.

Beta Risks - The probability of erroneously accepting the null hypothesis.

Binomial Distribution - Describes the distribution of probabilities when there are only two possible outcomes for each trial of an experiment.

Central Tendency - The center of the distribution of measurements. The most commonly used measures of central tendency are the median, the mode, and the mean.

Confidence Intervals - The interval about the sample statistic that is believed to include the population parameter within a specified confidence level.

Confidence Level - Probability of not rejecting the null hypothesis when the null hypothesis is true (1-alpha).

Correlation - The degree to which two variables are related.

Curvilinear Models - A mathematical equation which characterizes the curved relationship between two variables. If a scatter diagram suggests something other than a straight line, it is a curvilinear regression.

Degree of Freedom - (df) - The number of independent pieces of information associated with a given factor (usually the number of factor levels minus one).

DOE - Design of Experiments - An experiment that derives the required information with the least expenditure of resources. It provides a scientific approach to better understand how factors affect the performance characteristic.

F-test - A statistical technique which compares two variances. This technique is used to determine (1) if the two variances are significantly different and (2) if more than two means are significantly different. (Data II definition)

Histogram - A bar graph that plots frequency distributions. A histogram shows what proportion of time various measurements occur.

Hypothesis Testing - The comparison of a particular result to chance, determining whether the result is easily explained by mere chance variation or whether it is exceptional.

Independent - The probability of an event occurring is not affected by another event occurring or not occurring.

Linear Models - A mathematical equation which describes the linear (straight-line) relationship between two variables .

Mean - The arithmetic average.

Measures of Dispersion - Measures of overall spread in a probability distribution (the range, the average deviation, the standard deviation).

Median - The middle value of a group of measurements, counting from the smallest to the largest.

Mode	-	The most frequently occurring value in a data set.
Mu (μ)	-	The population mean.
n	-	The number of individuals in a subgroup; the sample size.
Nonparametric Statistical Methods	-	Statistical techniques for comparing two or more populations based on an ordering of the sample measurements according to their relative magnitudes. The techniques require few assumptions concerning the nature of the probability distribution. (Data II definition)
Normal Distribution	-	A symmetric bell shaped distribution following a particular probability function.
Null Hypothesis	-	Hypothesis of no experimental effect or change.
Poisson Distribution	-	A probability distribution used to describe the occurrence of unlikely events in a large number of independent repeated trials.
Pooled Variances	-	The combination of two sample variances (that are similar) to compute the best estimate for the population variance. (Data II definition)
Population	-	The total aggregate of observations that could ever occur in a given situation.
Probability	-	A ratio of a certain type of event to total events.
Probability Distribution	-	A complete description of the probabilities distributed over the entire range of a variable.
Random Sample	-	A sample in which observations are drawn from the population in a totally unbiased way.

Regression	-	Tells how one variable is related to others and allows using the known value of one or more variables to estimate the unknown value of other variables.
s (Sample Standard Deviation)	-	The measure of the dispersion associated with a data set. Standard deviation is the square root of the variance.
Sample	-	A group of observations taken from a population or a process.
Sample Size	-	The number of elements drawn from a population and analyzed to estimate its characteristics.
Sigma (σ)	-	The Greek letter used to designate a standard deviation for a population.
Significant	-	When the difference between sample results and hypothesized results is too large to be reasonably attributed to chance.
Skewed Distribution	-	A non-symmetric distribution.
SPC	-	Statistical Process Control is the use of statistical techniques to analyze a process or its outputs so as to take appropriate actions to achieve and maintain a state of statistical control and to improve the process capability.
Standard Deviation	-	A measure of dispersion. The standard deviation, in addition to the mean, fully defines a normal distribution.
Statistic	-	A number computed from a sample of observations. Statistics have an inherent error when used to describe the population.
Stratified Samples	-	A sample created by dividing a population into groups and drawing a sample from each group.

t Test	-	A statistical technique for testing hypotheses concerning unknown parameters.
Type I Error	-	Erroneous rejection of the null hypothesis; probability = alpha.
Type II Error	-	Erroneous failure to reject the null hypothesis; probability = beta.
Variable Data	-	Quantitative data, where measurements are continuous.
Variance	-	A measurement of the dispersion from the central tendency. The measurement is represented in squared units. Standard deviation = $\sqrt{\text{variance}}$.
x-bar ($\bar{x}$)	-	The mean or arithmetic average of a set of data values.

APPENDIX C
SOFTWARE

A search for software to use in the class was conducted. The following materials reflect the information which was used to evaluate the potential vendors and benefits.

The decision to use both SAS and BBN RS-1 has been made.

PURPOSE OF EVALUATION

- To support training statistics, DOE, and SPC
- To introduce students to an available statistical analysis tool

SOFTWARE APPLICATIONS

- Statistical Analysis
- Graphics
- DOE
- QC

SOFTWARE PACKAGES

- Systat/Sygraph
- SAS/PC
- SPSS/PC+
- BBN
- Minitab

IMPLEMENTATION OPTIONS

- Provide software to student at completion of course
- Use software in class; students purchase as desired

PERFORMANCE

- Data management
- Analytic capability
- Graphics
- QC capability
- DOE capability
- Speed

DOCUMENTATION

- Manuals

EASE OF LEARNING

- Amount of training necessary for basic operation
  - Self-paced documentation
  - Tutorial
  - Courses
- Available training sources

EASE OF USE

- On-line help
- Versatility of menu use
- Ease of creating macros
- Ease of integration into current Compaq classes

ERROR HANDLING

- Error messages
- Troubleshooting assistance

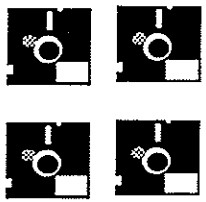
SUPPORT

- Support policies
- Technical support

VALUE

- Pricing structure
  - Purchase
  - Lease
- Upgrade policies
- Training expense

SOFTWARE EVALUATION



	(Weighting)	MINITAB	BBN	SAS/PC	SPCC/PC+	SYSTAT/ SYGRAPH
PERFORMANCE						
• Data management	(100)	G	S	E	E	E
• Analytic capability	(100)	VG	S	G	E	E
• Graphics	(50)	S	S	VG	G	E
• QC capability	(100)	G	S	G	P	G
• DOE capability	(100)	VG	S	E	NA	VG
• Speed	(50)	VG	VG	VG	VG	VG
DOCUMENTATION	(100)	VG	VG	G	E	E
EASE OF LEARNING	(100)	P	VG	P	G	VG
EASE OF USE	(100)	S	VG	P	VG	E
ERROR HANDLING	(50)	S	P	G	G	S
SUPPORT						
• Support policies	(25)	G	G	G	VG	VG
• Technical support	(25)	S	E	G	E	G
VALUE	(100)	P	S	P	S	E
TOTAL SCORE		5.7	5.9	6.0	6.5	8.6

E = Excellent **VG = Very Good** **S = Satisfactory** **P = Poor** **NA = Not Available**

COMPAQ

MANUALS

Software	No. of Manuals Per Site License	Cost for Addn'l Manuals
SPSS	1	$15 - $20
SAS	1	$12
SYGRAPH	2	$80

SELF-PACED TRAINING

Software	Training Packages	Training Method	Cost Each	Cost Site Lic.-Unlimited
SPSS	Faststart	CBT	$75	$900 ($500 renewal)
SAS	Fundamentals of SAS	CBT	$195 ($95 renewal)	$500 ($250 renewal)
SYSTAT	MYSTAT	Self-paced manual with exercise disk	$5	NA

TECHNICAL SUPPORT

Software	No. of Users Allowed to Call Per Site License
SPSS • Base • Statistics • Advanced Statistics	3 (1 for each software package)
SAS • SAS/Base • SAS/STAT	Unlimited
SYSTAT • SYSTAT • SYGRAPH	2 (1 for each software package)

PRICING STRUCTURE

SOFTWARE	COST BY NUMBER OF WORKSTATIONS							
	1		100		300		UNLIMITED	
	1st Year	Renewal	1st Year	Renewal	1st Year	Renewal	1st Year	Renewal
SPSS								
• Base	$ 195	NA	$ 1300	$ 815	–	–	$ 2000	$ 1250
• Statistics	295	NA	1300	815	–	–	2000	1250
• Advanced Statistics	295	NA	1300	815	–	–	2000	1250
• Tables	295	NA	1300	815	–	–	2000	1250
• Data Entry	295	NA	1300	815	–	–	2000	1250
• Graphics	295	NA	1300	815	–	–	2000	1250
SAS								
• SAS/BASE	$ 595	$ 275	$ 5875	$ 2375	$ 9295	$ 4300	NA	NA
• SAS/STAT	475	275	5195	2375	8175	3700	NA	NA
• SAS/GRAPH	475	275	5195	2375	8175	3700	NA	NA
• SAS/QC	475	275	5195	2375	8175	3700	NA	NA
SYSTAT								
• SYSTAT/SYGRAPH	$ 895	NA	NA	NA	NA	NA	$ 7000	$ 7000
• DESIGN	110	NA	NA	NA	NA	NA	NA	NA

APPENDIX D
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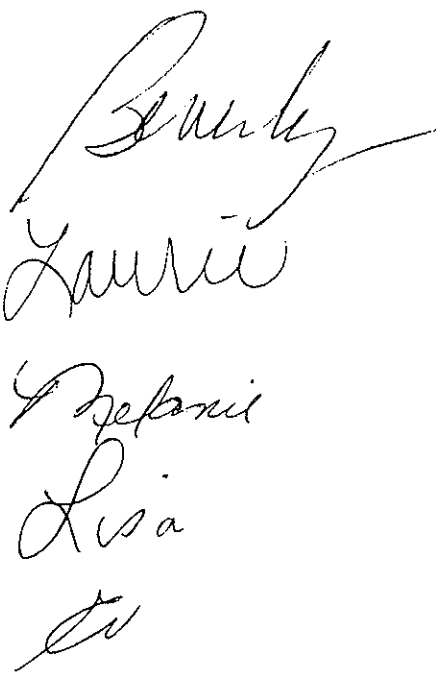
Thank you for taking the time to review the document. We appreciate it!